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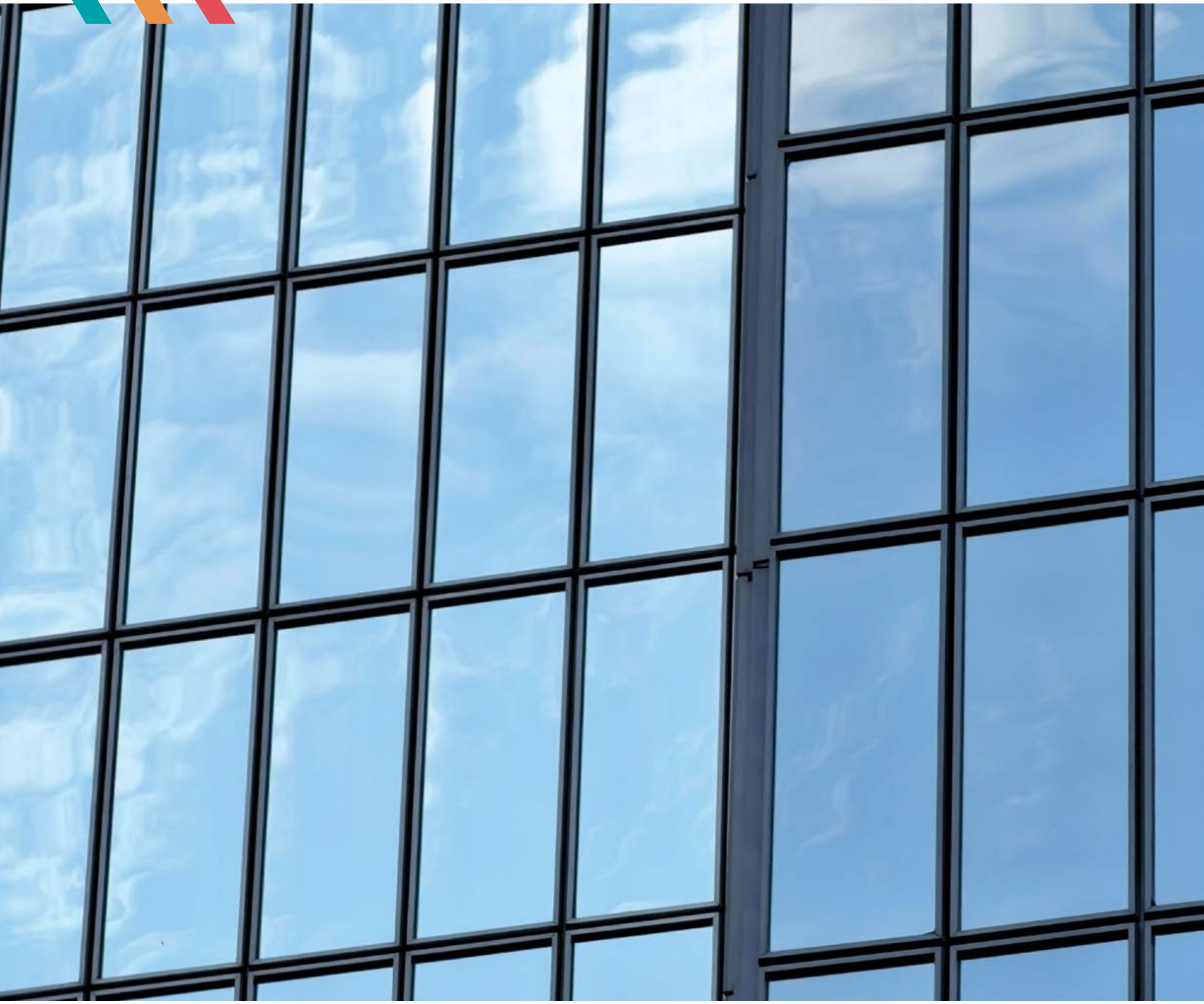

A Practical Guide to AAMA 501.2 Field Water Testing

By Rich Rinka

PHOTO COURTESY SHUTTERSTOCK

The Fenestration and Glazing Industry Alliance's (FGIA's) AAMA 501.2, *Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems*, provides quality assurance and diagnostic field water check method for installed storefronts, curtain walls, and sloped glazing systems. It helps specifiers ensure testing is conducted efficiently and consistently by providing guidelines for selecting field test specimens and the test procedures to be used for field water penetration checks. It also details the minimum contents that testing agencies or laboratories should expect to be included in test reports.

The field check is intended to evaluate the performance of joints, gaskets, and sealants in

Care needs to be taken to ensure there is proper water supply and flow. The nozzle and hoses need to be sized to provide proper water flow. This includes taking precautions to control the water pressure at the nozzle.

PHOTO BY CHRISTOPHER GREY/COURTESY SIMPSON GUMPERTZ & HEGER

fenestration products that are designed to remain permanently closed, watertight, and are not sealed using weatherstrip or weatherseals. This includes a wide variety of products, such as curtain walls, storefronts, sloped glazing, fixed windows and doors without a sash or panel, fixed unit skylights without weatherstrip/weatherseals, wall panels, perimeter sealants, and air and water barriers' integration with the fenestration product. Field checks are important to prove the performance of the components of a building and to identify areas of weakness. Performing field




Nozzle tests per AAMA 501.2 identified leaks at the perimeter of two glazing systems in this newly constructed three-story office building in California. The structure had both curtain wall and storefront systems installed. Testing was performed after construction was completed but before tenant occupation. Exterior facades were all in place, and, due to the shell-space nature of the structure, no interior finishes were installed. Testing identified leaks associated with the perimeter sealant and flashing detail. The compartmentalized nature of the test helped identify the likely entry point for the water penetration at the exterior.

PHOTOS COURTESY ADVANCED CONSTRUCTION TESTING

checks can be useful as part of a quality assurance program during building construction or during commissioning. The results of these field checks can identify remedial work and additional items to be included in the punch list for spot-checking throughout continued building construction.

AAMA 501.2 is not the appropriate test protocol to be used to test operable fenestration products (*e.g.* fixed windows and doors with a sash or panel, entrance systems, integral ventilating systems/devices, and operable unit skylights and roof windows). For those products, it is advisable to refer to AAMA 502, *Voluntary Specification for Field Testing of Newly Installed Fenestration Products*, which was developed to test the air leakage resistance and water penetration resistance of newly installed operable windows and doors. To test the impact of air leakage resistance and water penetration resistance for storefronts, curtain walls, and sloped glazing, specifiers should refer to AAMA 503, the *Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems*.

Remember that once a building has been occupied, AAMA 511, *Voluntary Guideline for Forensic Water Penetration Testing of Fenestration Products*, should be used for forensic water penetration testing of fenestration products. Once walls have been completed, more testing may be required to identify the source of issues, and the entire structure needs to be understood before testing is performed.

Test area preparation

It is important to determine the test specimen before conducting the actual test. AAMA 501.2 recommends using fully glazed units as specimens. They must be located on two typical floors of the building for testing curtain walls and on a typical floor for storefront or sloped glazing systems. For a curtain wall, testing is conducted across two floors to better reflect joint types.

The test area should be a representative sample of the whole building's construction and should not have any outstanding punch list items or other visible defects. One should ensure the test area includes perimeter sealant, typical splices, frame intersections, and at least two vision lites and spandrel lites containing intermediate vertical and horizontal members.

Testing must be performed as soon as the curtain wall is installed and sealants are cured, but before the drywall or other interior finishes are applied. On the exterior, allowing sealants to dry prevents water pressure from displacing installed sealant, while on the interior, this allows

Figure 1

FIGURE 1: Exterior Wall Cladding and Associated Components Applied

An example of how the test area should be reviewed prior to testing. In this case, some areas have not been completed, and testing in those areas would not yield valid test results.

PHOTO COURTESY FENESTRATION AND GLAZING INDUSTRY ALLIANCE (FGIA)

CHECKING QUALITY WITH THE AAMA 501 SERIES OF STANDARDS

Apart from FGIA's AAMA 501.2, *Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems*, test method, FGIA has published several documents in the 501 series to help building professionals with their quality checks.

AAMA 501, *Methods of Test for Exterior Walls*

This document provides detailed guidelines on laboratory and field test specifications for metal curtain walls. It includes performance characteristics of curtain walls, instructions on selecting test specimens and apparatus, and test methods as well as best practices.

AAMA 501.1, *Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure*

This standard establishes the equipment and procedures building professionals need to follow when using dynamic pressure to test exterior windows, curtain walls, and doors for water penetration.

AAMA 501.5, *Test Method for Serviceability of Exterior Fenestration After Thermal Cycling*

This test method provides a standard laboratory procedure building professionals can use to evaluate the permanent damage of thermal cycling on large fenestration components and cladding.

AAMA 501.4, *Recommended Static Testing Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drift*

This test method provides a means to evaluate the performance of curtain wall and storefront wall systems when subjected to horizontal displacements. The method is not intended to test dynamic, torsional, or vertical movements. For that, one should refer to AAMA 501.6, *Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System*.

AAMA 501.6, *Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall System*

AAMA 501.6 focuses on changes in the serviceability of wall systems (*e.g.*, air and water leakage rates) resulting from racking

for better visual inspection of the test area without removing and reinstalling interior finishes.

The specimen should be protected from extreme ambient conditions, such as high winds, rapid barometric pressure changes, heavy rain, and severe temperature changes, as these conditions can adversely affect the quality of field testing. If testing is performed under extreme environmental conditions due to unavoidable circumstances, this information should be included in the report.

Running the test

The testing agency needs the proper equipment and knowledge to run the test according to the procedure. Care needs to be taken to ensure there is a proper water supply and flow. The nozzle and hoses need to be sized to provide proper water flow. This includes taking precautions to control the water pressure at the nozzle.

The test is intended to be run on portions of the test area at a time. This allows for better identification of any problem areas. The test is performed by wetting the exterior surface in 1.53 m (5 ft) sections. Each section is wetted for five minutes. The test is performed starting with the lowest framing member and moved to adjacent framing members. Sections are tested from lowest to highest, so any sources of leakage are more easily identified. While one person is wetting the exterior surface, a second person is

on the inside watching for any water leakage. The observer may use appropriate tools, such as flashlights, mirrors, borescopes and water-sensitive paper to help detect any water leakage. The water leakage is noted at the location where it occurs.

Remember how water leakage is defined. Water leakage is uncontrolled water that is not contained or drained back to the exterior. Water contained within drained flashings, gutters, and sills is not considered leakage. The collection of up to 14.2 ml (0.5 oz) of water in a five-minute test displacements. This test method is suitable for large curtain walls and storefront mock-ups. This test method describes the apparatus and procedure for horizontally displacing a specimen. Building professionals must have a good understanding of static load applications, deflection measurements, and test fixture design to successfully apply this test.

AAMA 501.7, *Recommended Static Test Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-Story Movements*
A complement to AAMA 501.4, this test method provides detailed guidelines for evaluating the performance of windows, window walls, curtain walls, and storefront wall systems subjected to vertical displacements.

AAMA 501.8, *Standard Test Method for Determination of Resistance to Human Impact of Window Systems Intended for Use in Behavioral Care Applications*
This document provides a standard laboratory procedure for evaluating human impacts on window systems to be installed in behavioral care hospitals and facilities, as well as in other occupancies with similar concerns.

This test method uses a weighted impact device to apply force to simulate patients hurling themselves into window assemblies. This test method evaluates the effectiveness of the window system to resist such impacts. Caution is advised when applying test results to "in-service" conditions, as other variables, such as maintenance, are not accounted for by this test method.

AAMA 501.9, *Surface Temperature Assessment for Condensation Evaluation of Exterior Wall Systems*
This document provides a standard procedure for measuring surface temperatures when evaluating condensation in exterior wall systems under laboratory conditions. The assessment can be used to determine the potential for winter interior condensation.

Building professionals conducted water penetration testing in accordance with AAMA 501.2 to ensure compliance with contract documents, approved shop drawings, and industry standards, as well as the highest standards of quality and performance for a critical healthcare facility.

PHOTOS COURTESY GCI CONSULTANTS

period on top of an interior stop or stool integral to the system is also permitted under this test.

If water leakage occurs and the source cannot be identified, testing agencies will take additional steps to locate it. These additional steps and tests are needed to isolate the problem area to be addressed in the building. Care must be taken to ensure the exact source is located and remediation completed. Correcting at the source will help for a long-lasting resolution.

It is also advisable to randomly check for water leaks throughout the remainder of the project as construction progresses. Keep in mind that testing once may help identify a problem, but it is critical that random checks continue to ensure the remediation was correct and successful.

Final report

The final report should include information regarding the test that was performed. At a minimum, the test report should have the following information about the curtain wall specimen:

- Identification of the testing agency responsible for performing the work
- Information about the fenestration product that was tested, including, if available, manufacturer, model, dimensions, and materials
- Identification and locations of test specimens on the building
- Information about the building where the testing was conducted
- Any meteorological conditions that could have impacted the testing
- Physical condition of the curtain wall(s)
- A description of modifications, if any, made to the fenestration products

The report should include all results and any re-evaluations. It should also include a record of all points of water leakage, as well as a compliance statement indicating that the evaluations were conducted in accordance with AAMA 502.1. If there are deviations or meteorological conditions that could have impacted the testing, they must be highlighted in the report as well.

Successful use case

AAMA 501.2 was used during the construction of the City of Hope Cancer Center in Atlanta in 2022. This three-building complex includes a four-story clinic, a radiation center, and a surgery wing. This meant numerous tie-ins to existing structures, such as roofs, parapet walls, and expansion joints. Building professionals conducted water penetration testing in accordance with AAMA 501.2 to ensure compliance with contract documents, approved shop drawings, and industry standards as well as the highest standards of quality and performance for a critical healthcare facility offering fully integrated personalized cancer care services.

Conclusion

AAMA 501.2 is one of the most widely used field check methods for verifying the water leakage resistance performance of curtain walls. The test method gives specifiers, design professionals, contractors, and building owners the confidence that critical interfaces, sealants, and drainage paths are functioning correctly. The standard helps project teams reduce risk, improve long-term performance, and deliver curtain walls that meet design intent and occupant expectations. When used alongside related AAMA standards, the test methods help create a comprehensive quality assurance strategy, supporting durable, resilient, and well-integrated curtain wall systems.

additional information

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KEY TAKEAWAYS

AAMA 501.2 provides a standardized method for field water leakage testing of installed curtain walls and glazing systems, helping project teams verify performance, identify deficiencies early, and strengthen quality assurance during both construction and commissioning.

MASTERFORMAT NO.

07 27 00—Air Barriers
07 92 00—Joint Sealants
08 44 13—Glazed Aluminum Curtain Walls
08 41 13—Aluminum-Framed Entrances and Storefronts

UNIFORMAT NO.

B2020.10—Window Wall / Curtain Wall Systems

KEYWORDS

Division 07, 08
AAMA 501.2
Curtain walls
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Smart Door Solutions for Data Centers

Critical Specs for Reliable Protection

By Heather Bender

PHOTOS COURTESY CLOPAY CORPORATION

The rapid growth of cloud computing, artificial intelligence (AI), and digital infrastructure is driving a breakneck pace of data center construction. From multi-tenant colocation facilities to hyperscale campuses, these structures vary widely in size and scope but share basic functions focused on 24/7 operations and protecting equipment and personnel.

The operational goals of data centers demand precise specification of building envelope materials, to which commercial doors can make an important contribution. Effective door systems must address five core performance requirements: maintaining stable interior environments through thermal and air control; meeting the durability demands of equipment movement and high-cycle use; securing access between zones and controlling who and what moves through a facility; containing smoke and slowing the spread of fire during life-safety events; and integrating with building alarm and automation systems to respond automatically when conditions change. Together, these requirements ensure that servers, racks, and networking systems function predictably and reliably and that occupants and equipment are protected when it matters most. In data centers, commercial doors are more than basic building components; they are complex systems integral to operational success.

Common data center models

Data centers are often seen in a catchall manner, but their sizes, configurations, and occupancy patterns vary widely. A facility may serve one organization or multiple tenants, and it may be a single-level structure or a multi-story building. These variations affect access points, security requirements, and life-safety, determining door system placement and performance criteria.

Three of the most common data center models are colocation, enterprise, and hyperscale. Each has distinct functions, layouts, and levels of human occupancy, with important implications for door system specification.

Colocation facilities are operated by a single owner that maintains the building infrastructure while leasing secure suites to multiple tenants.

These seals on elevator openings in this data center prevent smoke from spreading in multi-floor facilities, ensuring clear paths for occupants and first responders.

Tenants in colocation facilities share systems such as power, cooling, and security while maintaining their own separate, access-controlled spaces. This model is common in urban locations and is often a multi-story structure that maximizes vertical real estate. Its multi-floor architecture, tenant separation requirements, and frequent equipment movement and servicing activities demand a wide range of door system solutions. These include securing individual tenant spaces and controlling access, as well as high-cycle durability required to handle recurring equipment movement, deliveries, and tenant access.

Enterprise data centers are owned and operated by a single organization to support its own internal IT infrastructure. Unlike multi-tenant colocation facilities, enterprise data centers do not lease space to outside tenants. The owner manages access, security, and operations, and these facilities are often integrated into larger occupied buildings such as corporate headquarters, hospitals, universities, or financial institutions. Enterprise facilities rely on internal staff, which results in more streamlined occupant circulation patterns. However, their proximity to other enterprise operations necessitates tight coordination with the building-wide life-safety system, making fire and smoke protection and alarm-integrated door operation especially critical performance requirements.

Hyperscale data centers are campus-style facilities designed to support massive computing workloads for cloud services, AI, and large-scale enterprise applications. Typically owned and operated by a single organization, these facilities feature high-density data halls with very low human occupancy, as operations are largely automated. Compared with colocation and enterprise models, hyperscale door system specification is more standardized, with the same assemblies repeated across multiple halls and zones. For specifiers, this consistency demands focused attention on thermal and air control performance and high-cycle durability, as any shortfall in either is multiplied across every repeated opening in the facility.

Shared needs of door systems and data centers

No matter the type of data center, nearly every model shares a core set of performance requirements informing door system specification. These requirements cut across all facility types and all zones: strong thermal resistance to protect tightly controlled interior climates; robust air infiltration management to limit humidity and airborne contaminants; high-cycle durability to withstand concentrated periods of use; reliable security and access control to protect people, equipment, and data; and fire and smoke protection integrated with building alarm systems to contain risk and support life-safety response. Viewing data centers through these common requirements and the zones where they apply makes it easier to identify door types that align with a facility's needs and specify assemblies that deliver optimal performance.

Exterior access: Loading docks and equipment bays

Loading docks and equipment bays accommodate the physical movement of server racks, cabinets, switchgear, uninterruptible power supply (UPS) systems, and large mechanical components. Crated shipments and palletized freight regularly move in

This insulated rolling door features advanced thermal breaks and perimeter seals to maximize thermal efficiency in data center facilities.

and out of these openings, and during buildouts or equipment refresh cycles, activity is high.

A multi-story urban colocation center may employ a ground-level dock paired with freight elevators. An enterprise facility integrated into a hospital or corporate building may have a secured service entrance separate from public-facing space. Meanwhile, a hyperscale campus may feature numerous loading areas designed for repeated deliveries. Though configurations differ, the performance demands at exterior access points are among the most rigorous in the facility, where thermal control, air infiltration management, durability, and security must all perform simultaneously and reliably.

Two door types are specifically engineered to meet these demands at exterior access points: insulated overhead sectional doors and insulated rolling doors.

Insulated overhead sectional doors

In data centers, insulated overhead sectional doors are the workhorse solution for exterior access. These engineered systems are where section construction, insulation, joint configuration, sealing, and reinforcement work together to meet the thermal, air infiltration, durability, and security demands of high-activity openings. Some of the latest advances available within this door category include:

Section construction and structural integrity

Insulated sectional doors should be specified with a 76.2-mm (3-in.), multi-layer section. This section typically uses a steel exterior and an interior steel backing. Reinforced end stiles and internal support elements enhance rigidity, helping to resist wind pressures and incidental impacts common in loading docks and equipment bays. Rugged section stiffness also preserves insulation continuity and long-term thermal resistance.

Polyurethane core insulation

Thermal efficiency begins at the section core. During manufacturing, polyurethane insulation is injected between the steel skins, where it expands and bonds to both interior and exterior surfaces. This foamed-in-place method minimizes gaps within the section and forms a continuous insulating layer. Depending on configuration and testing methodology, overhead sectional doors constructed this way can achieve R-values of up to 27 when evaluated according to the Door & Access Systems Manufacturers Association (DASMA) TDS-163, *U-factor and R-value for Residential and Commercial Garage Door*, thereby supporting stable interior conditions at critical openings.

Thermally controlled section joints

Section-to-section joints are a frequent source of heat loss. Advanced joint geometries, such as interlocking tongue-and-groove profiles, incorporate nonconductive separation between steel layers to limit thermal bridging. By interrupting metal-on-metal contact between sections, door systems maintain greater uniform insulation performance across the full door height.

Whole-assembly thermal performance

While the section R-value is often cited, overall door efficiency is better reflected by the U-factor, which accounts for the entire assembly. Through integrated insulation, thermally broken joint design, and precision section construction, high-performance sectional doors can now reach U-factors as low as 0.16 in testing under DASMA 105, *Test Method For Thermal*

Energy-efficient sectional doors and insulated rolling doors at data center loading bays deliver superior insulation and help maintain consistent indoor climates.

Transmittance and Air Infiltration of Garage Doors, indicating strong resistance to heat transfer across the entire system.

Air-sealing strategies

Air leakage directly affects humidity and temperature control in data centers, making perimeter sealing critical. Flexible PVC vinyl bottom perimeter seals conform to minor floor irregularities, while close-tolerance section construction and coordinated jamb and header seals reduce unintended airflow. Properly specified systems can limit air infiltration to 7.32 $m^3/h{\cdot}m^2$ (0.40 cfm/ft^2) or lower, in accordance with the 2015 *International Energy Conservation Code* (*IECC*) (Section 402.5.2).

Wind-load reinforcement

Exterior bay doors are often subject to significant wind pressures. Reinforcement options, referred to in the industry as struts, can be integrated into the section assembly to help alignment and seal compression under load. Depending on configuration, overhead sectional doors can be

Figure 1

ENERGY-EFFICIENT OVERHEAD SECTIONAL DOOR COMPONENTS

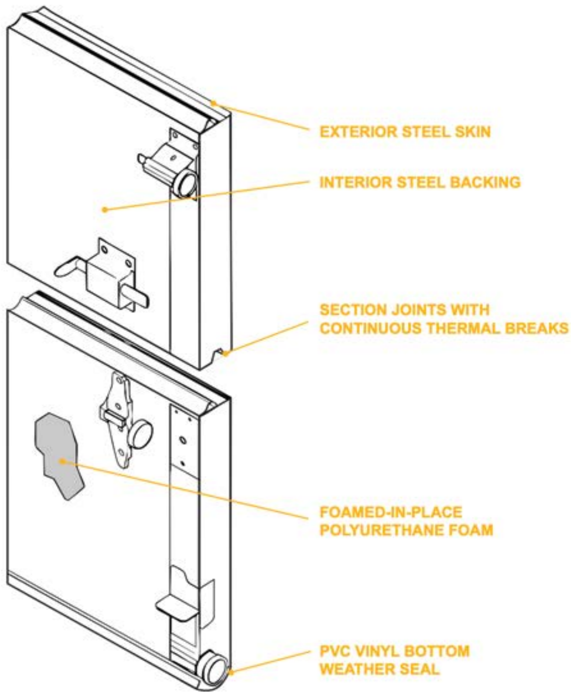
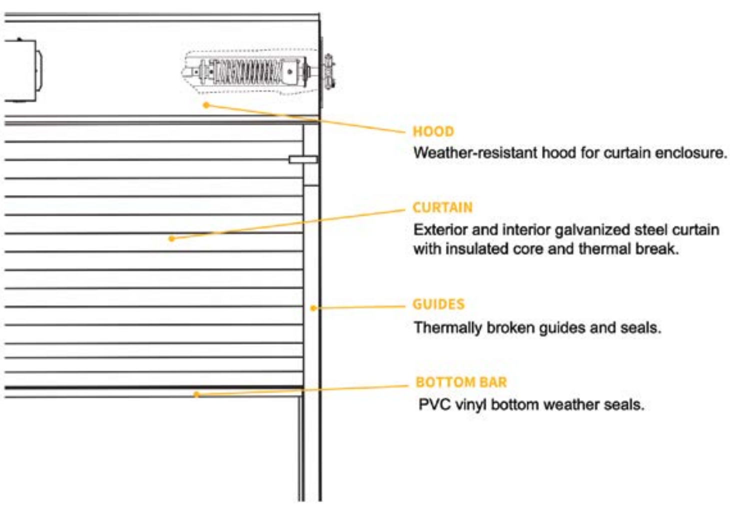


Figure 2

INSULATED ROLLING DOOR COMPONENTS



Top: This diagram illustrates the energy-efficient characteristics of overhead seasonal door components.

Above: This diagram illustrates the various components of insulated rolling doors.

engineered to meet pressures exceeding 2394 kPa (50 psf), supporting both structural integrity and building envelope performance.

Energy code alignment across climate zones

When all the preceding attributes are combined within a single assembly, overhead sectional doors can meet or exceed *IECC* thermal performance criteria, including U-factor thresholds of 0.37 or less across Climate Zones 1 through 8.

Insulated rolling doors

These doors are preferred when space constraints, opening size, or windload requirements demand a compact, vertically coiling system. In multi-story facilities, insulated rolling doors are often installed in upper-story loading bays, service entrances, and equipment transfer points where overhead space is limited. These locations demand a balance of durability, seamless operation, and environmental control. Insulated rolling door advantages that speak to the needs of data centers in this area include:

Compact footprint and operational reliability

Rolling doors preserve interior square footage and clearances by coiling vertically into a relatively small overhead space. They are particularly well-suited for upper-level loading bays and constrained service areas. At the same time, their heavy-duty construction supports reliable operation during demanding usage cycles, including equipment upgrades and infrastructure refresh cycles.

Double-wall insulated curtain construction

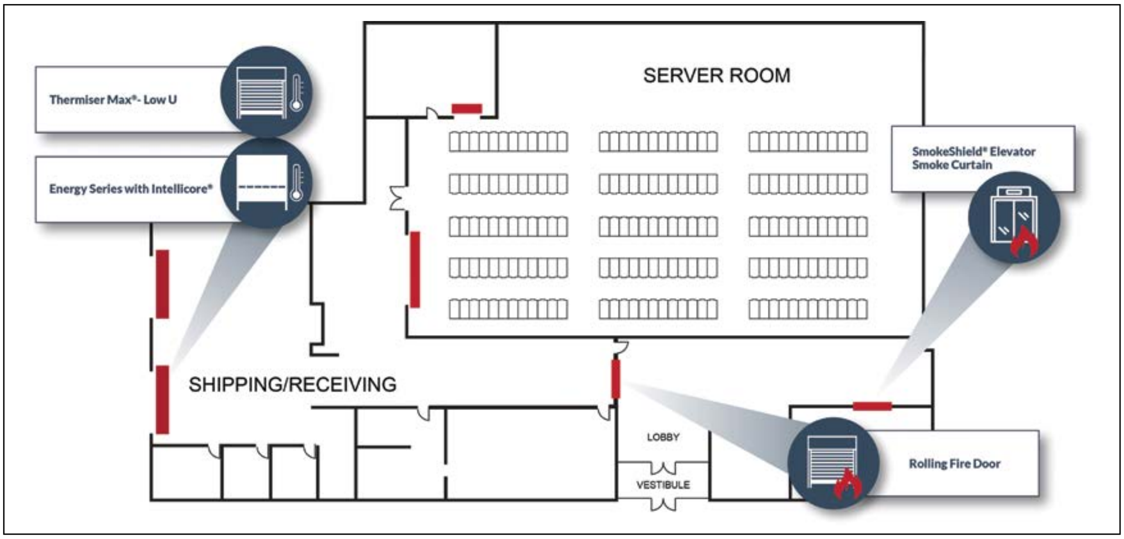
The rolling door curtain comprises interlocking steel slats that coil into a compact barrel above the opening. In insulated models, the slats feature a double-wall configuration with insulation between the interior and exterior steel layers. This design adds rigidity and thermal resistance, forming the foundation of the door's energy performance.

Thermally broken curtain design

Traditional steel slat construction can create conductive pathways; therefore, advanced insulated rolling doors incorporate low-conductivity thermal breaks within the slat assembly. These components interrupt metal-on-metal contact and reduce thermal bridging across the curtain surface while preserving the structural strength necessary for large openings and frequent cycling.

Thermally enhanced guide construction

The vertical guides that anchor and align the rolling door curtain are common sources of conductive heat loss. Enhanced guide designs incorporate thermal breaks in the guide profile to reduce energy transfer at the jambs. When paired



Insulated and fire-rated doors are strategically placed throughout data centers to maintain critical climate control, security, and fire protection.

with integrated perimeter sealing systems, these thermally broken guides support tighter envelope control at the perimeter.

Engineered perimeter sealing systems

Air leakage through large service openings can undermine interior temperature stability and humidity control, two critical considerations in data center environments. Insulated rolling doors incorporate coordinated sealing along the guides, bottom bar, and hood interface to create continuous compression around the opening. Some models currently available feature independently tested assemblies that can achieve air infiltration rates below 5.48 $m^3/h{\cdot}m^2$ (0.3 cfm/ft^2), aligning with the performance expectations of ASHRAE 90.1, *IECC 2021*, and *California Title 24*.

Insulated hood assemblies

The hood protects the curtain and operating mechanism from exposure to damage and dust. When insulated and properly sealed, it also reduces heat loss at the header, where warm air naturally accumulates, creating more consistent full-assembly performance.

Whole-assembly U-factor performance

An insulated rolling door's overall assembly—curtain, guides, hood, and perimeter seals—determines how effectively the door limits heat transfer. With a properly coordinated design, some models achieve full-assembly U-factors as low as 0.53 when tested in accordance with DASMA 105. For specifiers, this provides a clearer indication of how the total assembly will perform within the building envelope.

Interior compartmentalization and fire protection

Inside a data center, designers compartmentalize operational activities and establish fire-rated boundaries around areas such as electrical and generator rooms, UPS and battery storage spaces, mechanical and cooling support areas, telecom closets, server corridors, and elevator shafts. In multi-story colocation facilities, these areas are frequently mirrored and stacked from floor to floor. Enterprise data centers may integrate them into the broader context of the occupied building, while hyperscale campuses use repeated patterns of compartmentalization and fire protection to mitigate risks across larger footprints.

Rolling fire doors, fire counter doors, and elevator smoke curtains help define and separate these compartments while preserving the necessary movement and safety of tenants, maintenance personnel, and IT technicians. While different in application, each solution is designed to mitigate the spread of smoke and slow the advance of fire while supporting other day-to-day operational needs.

Rolling fire doors

Rolling fire doors are the primary solution for data hall compartments and tenant suites where large openings require both reliable daily access and fire-rated protection. Advanced designs can integrate with a facility's primary fire alarm system, allowing them to close automatically when an alarm is triggered or if power is lost. This active integration provides faster response than traditional thermally triggered doors, which rely on heat-sensitive fusible links and may not close until smoke or flames have already reached a damaging level. Specifiers can designate smoke and draft control features tested to Underwriters Laboratories (UL) 1784, *Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives,* that help prevent smoke migration into adjacent compartments and protect equipment throughout a facility. Rolling fire doors are available with fire ratings up to four hours, aligning with code requirements and design intent.

Fire counter doors

Fire counter doors are designed for smaller openings, such as storage areas or workrooms, providing the same passive fire protection as larger rolling fire doors in a more compact format. Like their counterparts, these doors can be specified with integrated alarm system connections, enabling automatic closure during fire events or power outages. Advanced motorized operators, including battery-backup designs, allow doors to close reliably even during temporary power loss, then reset automatically once the alarm clears. Fire counter doors combine structural integrity with durability, making them ideal for spaces with frequent access while still meeting UL fire ratings up to three hours. Optional smoke gasketing systems, such as perimeter seals integrated into the door guides, provide additional protection against smoke migration.

Elevator smoke curtains

Elevator smoke curtains protect the hoistway openings of elevators and service shafts that support staff movement, equipment transport, and building services in multi-story data centers. Curtains can also be transparent for visibility during evacuation and emergency response. Deployment can be triggered by fire alarm systems, smoke detectors, manual activation, or power loss, and battery-backed motorized models ensure reliable operation during outages. During an event, the curtain can also be manually raised in emergencies. Available compact profiles occupy minimal headroom, and all installations comply with relevant codes and standards, including *International Building Code* (*IBC*), UL 1784, and ICC-ES AC77, *Acceptance Criteria for Fire-Resistive Smoke Curtains*, ensuring safe and reliable operation without interfering with vertical circulation.

Aligning priorities without sacrificing door performance

From exterior loading docks and equipment bays to interior compartmentalization and fire safety, the right commercial door system must go beyond basic functionality to deliver on all five performance requirements: thermal and air control, durability, security, fire and smoke protection, and building system integration. By evaluating common data center layouts and recognizing shared requirements, specifiers can readily identify the advanced door systems that support the facility's mission-critical objectives.

additional information

AUTHOR

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KEY TAKEAWAYS

Data center door systems must deliver on five core performance requirements: thermal and air control, durability, security, fire and smoke protection, and building system integration. At exterior openings, insulated sectional and rolling doors address thermal resistance, air-sealing, and high-cycle durability. At interior boundaries, fire-rated rolling doors, counter doors, and elevator smoke curtains contain risk. Specified correctly, these systems safeguard sensitive equipment, protect occupants, and keep mission-critical operations running without interruption.

MASTERFORMAT

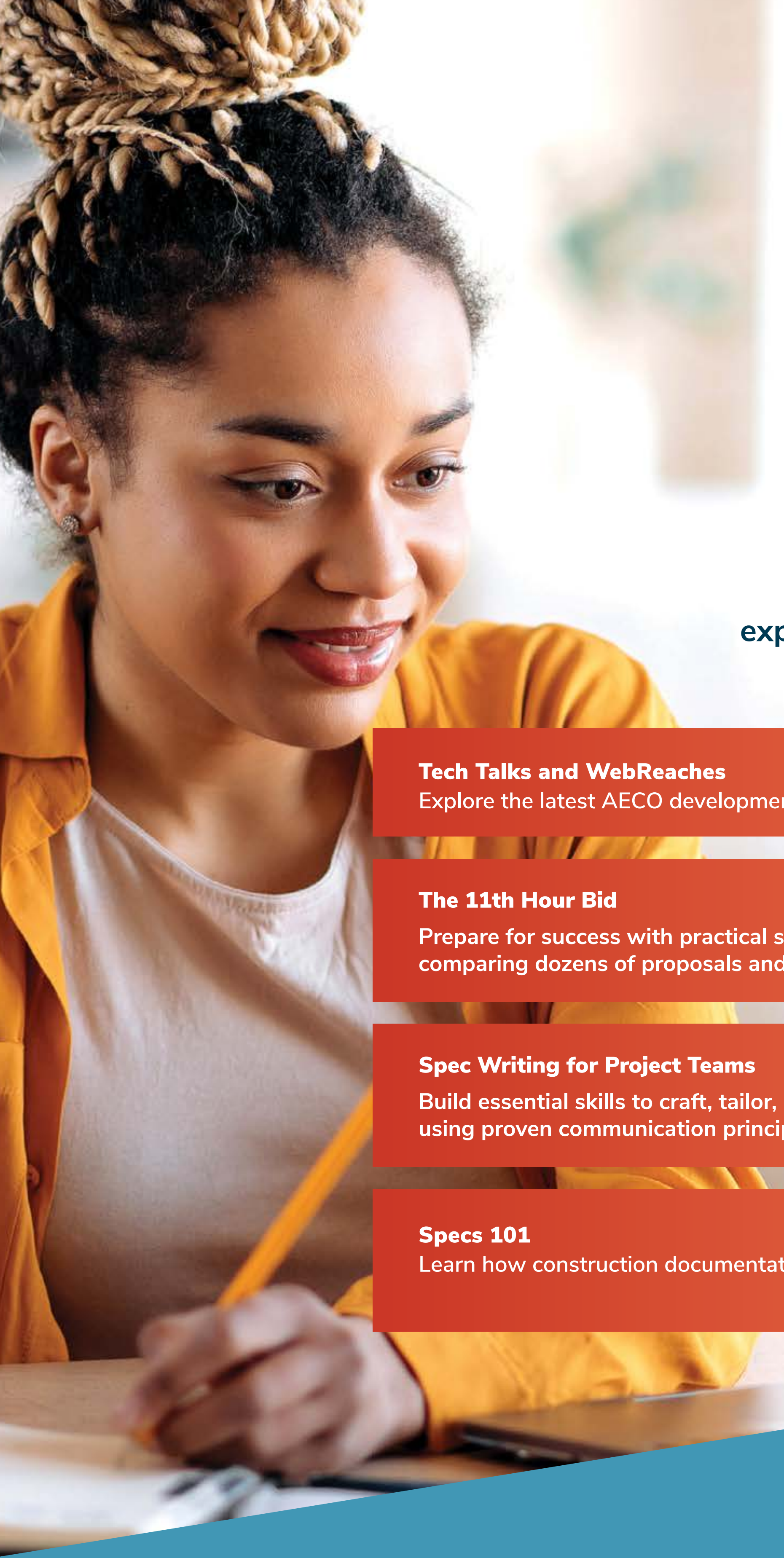
08 33 00—Coiling Doors and Grilles
08 36 00—Panel Doors

UNIFORMAT NO.

B2030—Exterior Doors
C1030—Interior Doors

KEYWORDS

Division 08
Data centers
Commercial door systems
Thermal efficiency
Fire protection



Building Enclosure Commissioning

Defining and Specifying an Effective BECx Scope

By Colleen Stuber, AIA, LEED AP, BECxP

PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

Many building enclosure failures begin with small issues or coordination gaps during design or construction that go unnoticed and undermine long-term building performance. Identifying enclosure issues early in the design and construction process reduces complications and cost compared to addressing problems after concealed conditions begin to affect building systems and occupants. Complex building enclosure assemblies and material transitions require careful design, precise construction, and coordination among multiple trades and manufacturers. An expert third party to review and verify performance goals in each project phase can help mitigate risk and maintain the owner's quality and performance expectations. Without this oversight, project teams may overlook issues in enclosure design, installation, and material interfaces that escalate into more significant problems.

Figure 1

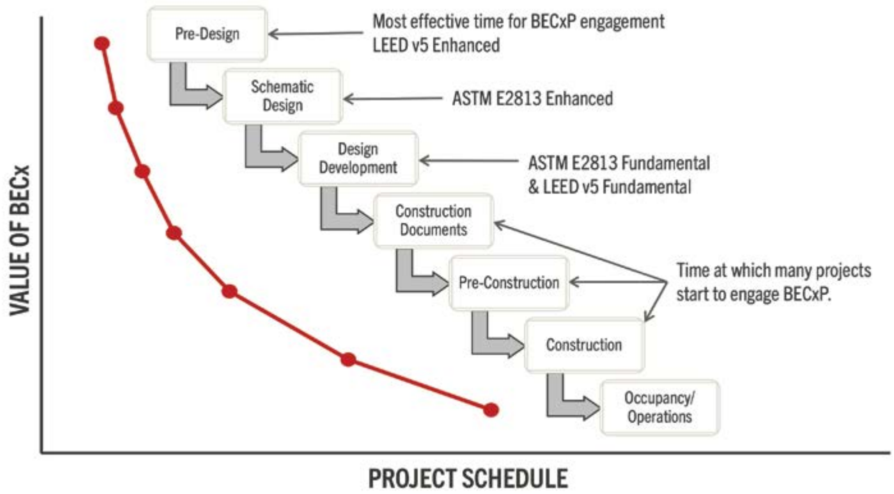


Figure 1: BECxP Project Phase Engagement

Early engagement of the BECxP during the pre-design or schematic design phases is the most effective approach and is now required under LEED v5 and ASTM E2813.

DIAGRAM COURTESY SIMPSON GUMPERTZ & HEGER

Building enclosure commissioning (BECx) provides a structured, third-party quality assurance and risk management process verifying that the design, installation, and performance of enclosure systems meet the owner's project requirements throughout the project. Although not a new concept, the formal BECx process has evolved significantly in the past two decades. What began in the shadow of the mechanical commissioning process has developed into its own segment of the building industry, shaped by expanding energy codes, sustainability programs, and industry guidelines. Despite this growth, many project teams still struggle to clearly define the BECx scope in their specifications. Unclear documentation leads to inconsistent implementation, gaps in responsibility, confusion around enclosure testing, and unrealized owner expectations.

History of industry guidelines

The complexity of building enclosure systems, more stringent energy code requirements, and owner expectations for durability and lifecycle cost have driven the need for a systematic approach to enclosure design, installation, and verification. The energy crisis of the 1970s prompted the building industry to reconsider its approach to energy efficiency, leading to BEPCx and a more structured approach to HVAC commissioning. The first industry commissioning standard was created by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) with the ASHRAE Guideline 1-1989, *Guideline for Commissioning of HVAC Systems*. This introduced a systematic approach to verifying the testing and performance of mechanical systems as an energy-efficiency measure.

The industry has since refined and expanded this framework beyond HVAC to define a broader commissioning process (Cx) applicable to all building systems, as outlined in ASHRAE Guideline 0-2004, *The Commissioning Process*. This guideline influenced the development of commissioning practices for building enclosures. It led the National Institute of Building Sciences (NIBS) to publish Guideline 3-2006, *Exterior Enclosure Technical Requirements for the Commissioning Process*. While NIBS Guideline 3 established a comprehensive process, the industry sought clearer minimum performance requirements to support consistent application across projects. This need led to the current industry standard, ASTM E2813, *Standard Practice for Building Enclosure Commissioning*, and the accompanying ASTM E2947-21a, *Standard Guide for Building Enclosure Commissioning*. ASTM E2813 defines minimum requirements

Full-scale mockups of the Wichita State University Biomedical Campus can verify the performance of critical enclosure details and system interfaces through testing, enabling the team to evaluate aesthetics and improve sequencing and trade coordination.
PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

for fundamental and enhanced levels of BECx on a project, while ASTM E2947-21a provides detailed procedural guidance for implementation.

LEED

BECx gained traction over the past two decades, driven in part by the LEED sustainability certification program. LEED has consistently aimed to transform sustainability goals into standard industry practice by increasing baseline performance requirements with each version. LEED v3 (2009) first recognized BECx by allowing project teams to earn Innovation in Design (IDc1) credits for envelope commissioning.

In LEED v4 (2013) and v4.1 (2018), the program expanded commissioning requirements to include building enclosure commissioning within the Energy and Atmosphere (EA) Prerequisite for Fundamental Commissioning and the Enhanced Commissioning credit, which included an option for envelope commissioning. This shift reflected growing industry interest in BECx; however, the LEED v4 Reference Guide generally reflected a limited scope and retained terminology from mechanical commissioning that does not fully apply to enclosure systems, such as seasonal testing. LEED referenced ASHRAE Guideline 0, NIBS Guideline 3, and later ASTM E2947 (added in v4.1) for additional guidance, but provided limited direction on how to define the project-specific scope of BECx.

In LEED v5 (2025), the scope of both fundamental and enhanced commissioning has expanded significantly. Fundamental commissioning, a prerequisite for all enhanced commissioning options, now requires increased construction-phase oversight, including submittal reviews, QA/QC checklist tracking, participation in milestone meetings, and observation of testing. It also requires compliance with ANSI/ASHRAE/IES Standard 90.1 commissioning requirements rather than referencing them as guidance. The Enhanced Commissioning credit for building enclosures (1 point) requires compliance with ASTM E2947-21a and specific field-testing procedures, significantly increasing the scope of BECx services from LEED v4.1. By expanding commissioning requirements again in LEED v5, the program continues to drive higher expectations for enclosure performance and influence the evolution of industry practice.

Energy code

The 2021 and 2024 editions of the *International Energy Conservation Code* (*IECC*), ASHRAE 90.1 (2016 through 2024), and many state and local energy codes include requirements for performance testing and enclosure verification. Air barrier compliance provisions now require whole-building air leakage testing in some jurisdictions, with alternative compliance paths that include enclosure design review, installation verification, and final commissioning documentation. These requirements function as an abbreviated form of BECx, closely mirroring key steps in the commissioning process and signaling a broader shift toward performance verification of building enclosures.

Defining an effective BECx scope

Project initiation phase

While industry standards and guidelines have established a framework for building enclosure commissioning, they do not define a one-size-fits-all scope for every project. Project teams must interpret these requirements and translate them into a project-specific BECx scope that aligns with the owner's goals, budget, and schedule. This process often begins during project initiation, where the content of proposal requests and provider qualifications can significantly influence the effectiveness of the BECx process.

RFPs and RFQs

The owner or the architect typically defines the BECx scope of work in a request for proposal (RFP) before engaging a building enclosure commissioning provider. However, they may not fully understand the nuances of the specific tasks, the needs of the building type or complexity, or the implications of certain scope items on the budget or schedule. Even when relying on current sustainability standards and commissioning guidelines, project teams may select a scope that exceeds the project's needs or unintentionally limits the BECx process from delivering the intended value.

As a result, some owners issue requests for qualifications (RFQs) without a defined commissioning scope during the early planning stages of a project, often before predesign begins. This approach allows the BECxP to join the project team early, provide input on enclosure performance goals, and develop a project-specific commissioning scope that aligns with the owner's objectives. Early collaboration also helps establish realistic expectations for scope, cost, and schedule, improving the overall effectiveness of the BECx process.

Chamber testing of repetitive cladding attachment components for air leakage in accordance with ASTM E1186 can verify the performance of typical fastener installations.

PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

The BECxP

Industry guidelines have begun to provide measures for defining the BECxP's level of experience and the timing of their onboarding to the project. The BECx process is typically conducted by a neutral third-party building enclosure consultant, engineer, or architect specializing in building science with extensive experience in design, construction, testing, performance, and maintenance of roof, exterior wall, fenestration, and waterproofing systems. The ASTM E2947 and E2813 standards detail the BECxP as being trained and experienced in the BECx process and having proficiency in the core competencies of building and material science, procurement and project delivery, contract documents and construction administration, and performance test standards and methodology. LEED v5 additionally requires that the commissioning provider has experience completing commissioning on at least two projects of equal or larger scope and complexity.

The BECxP is most effective when engaged early in the design phases, allowing the team to define and align enclosure performance goals with the building's function, size, complexity, and long-term maintenance. Early involvement leads to a more clearly defined BECx scope, integrates commissioning requirements into the contract documents, and supports coordination of the process across all project phases. LEED v5 requires that the owner designate a commissioning provider by the end of design development for fundamental commissioning and by predesign for enhanced commissioning. (See Figure 1, page 23)

Design phase

In predesign, the process typically begins with the BECxP conducting a kickoff meeting with the design team and the owner to set expectations, clarify each party's roles and responsibilities, and review the BECx scope and objectives for each phase. The BECxP creates or reviews the Owner's Project Requirements (OPR) document, which includes measurable performance standards and long-term resilience factors for the building enclosure systems. This document becomes crucial during the process, as it establishes the baseline for design, installation, and verification requirements at each project phase. However, this document can be fluid and should be updated as the project progresses. Larger institutional building owners sometimes use a standard document as the OPR. In this case, the BECxP would review and make recommendations for changes or additions to the enclosure performance requirements. When the owner lacks a document and does not know how to create one, the BECxP assists the owner in developing the OPR. The BECxP reviews the architect's basis of design (BOD) narrative against the OPR, creates an initial BECx plan, and develops the BECx specification section.

As the design progresses, the BECxP conducts a peer review of drawings and specifications at each design phase to verify compliance with the OPR's standards and participates in design meetings. This review can include a design issues log with a back check of comments in subsequent reviews.

BECx specifications versus BECx plan

The BECx specification section is a critical document that defines the commissioning scope and deliverables during construction and occupancy. It establishes roles and responsibilities for project team members, outlines communication protocols, and provides a clear location to

Roof installation site visit at 400 China Basin Street, a multi-family housing project located in San Francisco.
PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

define enclosure testing requirements. While the BECx plan often contains similar information, the two documents serve different distinct purposes and follow different development timelines.

The BECx Plan is developed early in the design process and addresses commissioning activities from predesign through post-occupancy. The project team updates this document throughout each phase, and it may not be finalized until project closeout or after the post-occupancy site visit.

In contrast, the BECx specifications are developed during design and finalized in the construction documents. Since the design phase has already occurred, the specifications typically focus on commissioning activities from preconstruction through post-occupancy. They represent the primary location where BECx requirements become part of the contractor's contractual obligations.

For this reason, the specifications should clearly define enclosure performance goals from the OPR and include detailed enclosure testing requirements. Clear documentation helps contractors understand the scope of work and plan for potential schedule and cost impacts associated with the BECx process.

BECx specification and BECx plan content
Commonalities
- BECx activities, scope, and deliverables
- BECx team roles and responsibilities
- Meetings, communication, and documentation protocol
- Project close-out requirements

Differences
BECx Plan
- Includes design, construction, and occupancy scope requirements
- Living document, updated at each phase
- Finalized at the close-out or post-occupancy of a project

BECx specifications
- Does not include project design scope requirements
- Part of contract documents, updated only minimally
- Finalized in construction documents
- Can contain an outline of the OPR
- Performance testing requirements

BECx specifications
It is recommended to include a dedicated BECx specification section in Division 01, typically Section 01 91 19—Building Enclosure Commissioning Requirements. This approach improves visibility in contract documents and enables clear cross-referencing in related enclosure specification sections. The BECx specification should clearly define performance expectations, scope, deliverables, and responsible parties to reduce coordination issues during construction.

BECx specification content
- Related sections—List all enclosure systems to be commissioned, and each of those sections needs to reference back to the BECx specification section.
- Reference standards—List the BECx industry standards that the project will be following.
- Definitions—Include any terms, roles, and acronyms specific to the BECx process.
- Project contacts—Include project team contacts involved in the BECx scope.
- Enclosure performance requirements—Include an outline or matrix exhibiting each enclosure system with the applicable building code minimum requirements and the project performance requirements.
- Documentation matrix—Include the documentation and deliverables along with who is responsible for creating, receiving, and approving them.
- Meetings—List all anticipated meetings, who is responsible for planning and distributing meeting minutes, and required attendees. These include the BECx construction kickoff meeting, pre-installation meetings, enclosure testing planning meeting, mockup meeting, and construction progress meetings.

- Enclosure testing requirements—List all required enclosure testing of related specification sections in the BECx specification to allow for ease of planning. Include detailed testing information to lessen the number of issues in the field, such as testing protocols for each enclosure system, including industry-standard numbers, test descriptions, test pressures, allowable reductions, and pass/fail criteria. Also include test frequency and location information: at what point in construction, how many tests (per system type, elevation, square footage), and who chooses testing locations (owner, architect).
- Responsibility—Who is performing and paying for the testing, hiring the testing agency, scheduling, and coordinating the testing site requirements (electricity, water, access).
- Repair and retesting procedures—Who is responsible for making repairs, creating a repair procedure, additional test locations after failure, and who pays for retesting and additional test locations.
- Parties to witness testing—Who needs to be present to witness testing, assist with repairs, and troubleshoot (BECxP, architect, installing contractor, general contractor, or manufacturer's technical representative).
- Type of documentation required—Report from the testing agency, report and issues log from the BECxP, and repair protocol from the installing contractor.

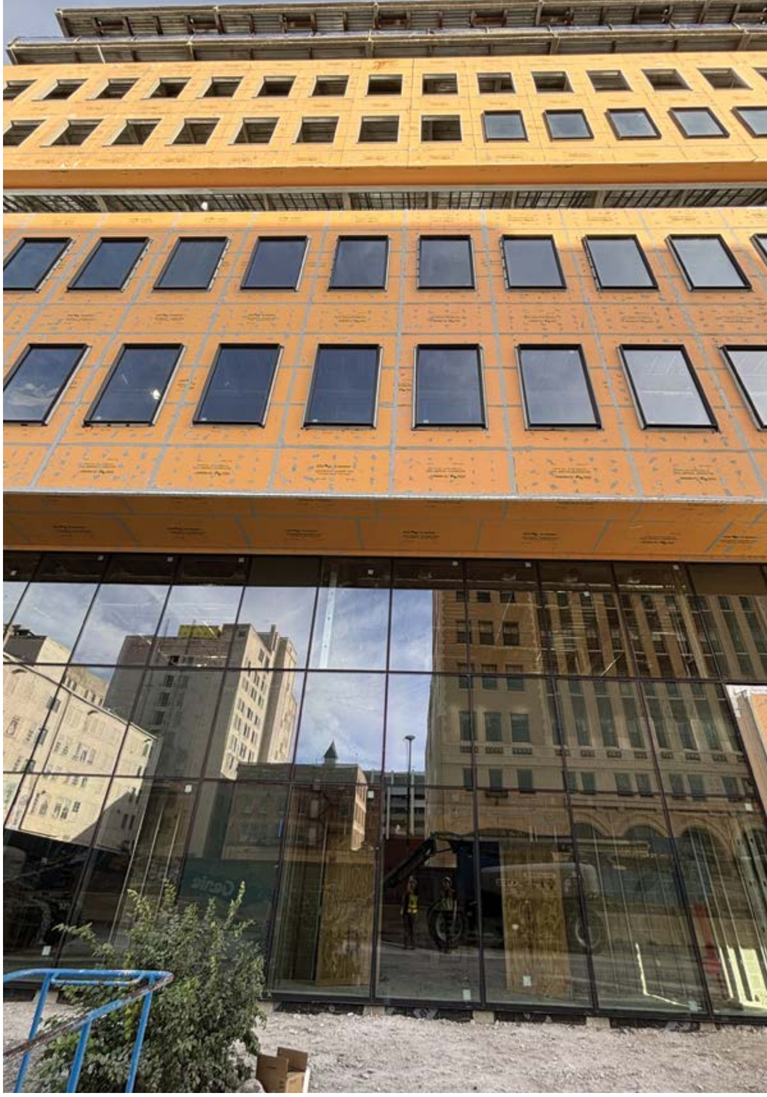
Design phase scope considerations

- OPR—Consider who is responsible for creating the OPR, how it is documented, and what content needs to be included to successfully communicate the depth and breadth of goals to the BECxP and the project team.
- BOD—Consider what the basis of design documentation is (a design narrative or drawings) and what content needs to be included (building system types, assembly information, code, performance, and sustainability requirements for the project).
- Design reviews—Consider how many design reviews and what document sets will be included in the BECxP's scope, how in-depth the reviews should be, and if comments need to be back checked. Will BECxP be involved in early design decisions, design assistance, or comparisons of enclosure systems?

Construction phase

As the project progresses into preconstruction, the BECxP shifts focus to constructability and design verification by reviewing contractor submittals and shop drawings, in conjunction with the architect, against the OPR and the construction documents. The BECxP should also participate in pre-installation meetings with installing contractors to review constructability, material compatibility, sequencing, QA/QC, and testing procedures for enclosure components. During this phase, the BECxP conducts site visits to observe the installation and testing of the enclosure mockup (see photos on pages 24 and 25).

As construction of enclosure systems begins, the BECxP performs site visits to review installation, witness or perform field testing, document deficiencies in an issues log, and verify corrective work with the contractor (see photos on these facing pages).



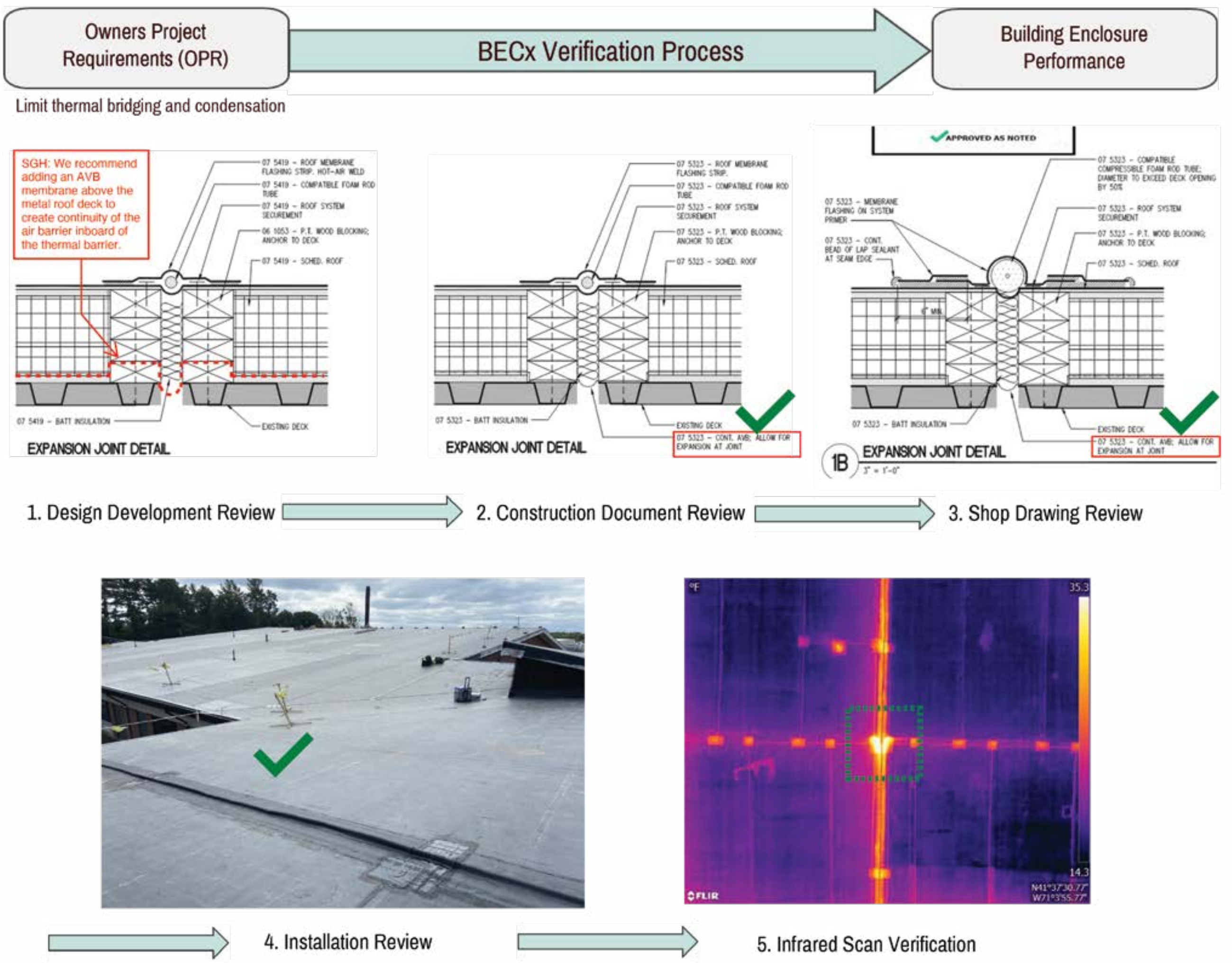
Exterior wall sheathing, weather barrier, and fenestration installation site visit at Wichita State University Biomedical Campus.

PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

Post-occupancy phase

The BECx process continues beyond construction. Approximately 10 months after occupancy, the BECxP returns for a post-occupancy inspection of the enclosure systems and reviews any ongoing issues with facility staff. The post-occupancy site visit should occur prior to the contractor's workmanship warranty period (typically one year). The BECxP documents reported or observed deficiencies and develops an issues log for resolution by the contractor before the warranty period expires.

Figure 2



One of the greatest benefits of the commissioning process is verifying that the Owner's Project Requirements are incorporated throughout each phase of the project.

DIAGRAM COURTESY SIMPSON GUMPERTZ & HEGER

Construction phase scope considerations

- Submittal review—Which systems are to be reviewed, number of revisions included in the review, type of documentation required (PDF markups and/or issues log), order of review protocol (before, after, or concurrent with design team), and comment back check requirements.
- Enclosure mockups and testing—Type of mockup (stand-alone, on-site, lab, in situ), systems included, who needs to review and approve, field testing procedures, and type of documentation required (report and issues log).
- BECxP site visits—Number of site visits, systems to be reviewed, schedule inclusion, site protocols, type of documentation required (report and issues log), and issues back check requirements.
- Enclosure testing—The type of enclosure testing and amount of testing that is needed for the project-specific enclosure systems to verify the installation and meet the owner's project goals.

Scope variables

The BECx scope can be expanded to include more in-depth design reviews, thermal modeling of detailed conditions, participation in enclosure pre-installation meetings, QA/QC plan reviews, mockup planning, field testing plans, performing enclosure testing, attending regular construction progress meetings, and creating systems training or maintenance plans.

The scope can vary greatly depending on:

- Owner's project goals—A long-term building owner, such as a university, may care about a low-maintenance, energy-efficient building with low operating costs, resulting in greater involvement in system selection in design, participation in pre-installation QA/QC verification, and additional site visits for oversight.
- Building type—A more sensitive building type, such as a museum or library, may have a low tolerance for water infiltration and condensation, resulting in more in-depth

design reviews, hygrothermal modeling of details, and additional field testing to verify performance.
- Building size and shape—A large complex building with many changes in plane may require more oversight and coordination than a small, simple structure.
- Number and complexity of enclosure systems—A building with multiple complex or custom enclosure systems and many material transitions may require more time spent understanding the manufacturer's installation instructions and compatibility than a building with typical cladding systems.
- Budget—The budget can greatly affect the number and depth of design reviews, submittal reviews, meeting attendance, and field testing.
- Schedule and project delivery methods—Project duration and delivery method can influence BECx scope, objectives, and timing of engagement. For example, design-build projects often require a more proactive, integrated quality assurance approach, with earlier involvement of the BECxP and increased collaboration during design and constructability reviews.
- Project phase—The stage when the BECxP becomes involved can significantly affect the scope and may limit the ability to commission the enclosure fully. Some certification programs also require BECxP involvement at specific project phases to achieve compliance or earn credits. (See Figure 1, page 23)
- Sustainability certification or industry standard requirements—Applicable certification programs or industry standards may dictate the BECx scope, required tasks, and level of BECxP involvement.

Verification

The greatest benefit of the commissioning process is verification throughout the project and the accountability that comes with it. The BECxP verifies that the OPR is reflected in the early design phases through installation verification and creates accountability for the project team. Early intervention of design and construction issues can improve:

- Risk mitigation of enclosure failures
- Quality assurance improvement
- Improved energy efficiency, lower operating costs, and improved occupant comfort
- Enhanced durability, lower maintenance, and longer service life of enclosure systems
- Heightened local energy code compliance and sustainability goals

As illustrated in Figure 2, a long-term building owner who commissions their building because they care about a sustainable, low-maintenance building may want to limit

Complex building enclosure assemblies and material transitions require careful design, precise construction, and coordination among multiple trades and manufacturers.

PHOTO COURTESY SIMPSON GUMPERTZ & HEGER

thermal bridging and avoid condensation in the enclosure assemblies. This may include measurable performance goals in the OPR, hygrothermal modeling in the design process, and the BECxP reviews the documentation and installation at each phase through this lens:

1. The design review would include verifying that the insulation and air/vapor barriers are continuous at transitions and are located appropriately within the assembly to avoid condensation, based on project conditions.
2. This would include comments in the design documents and issues log, which would then be back-checked in the construction documents to verify if the recommendations were incorporated.
3. The BECxP would then review the contractor's shop drawings to verify that those elements are incorporated and remain constructable. Ideally, the BECxP would be included in preinstallation meetings to verify that the installing contractors understand the details and how that specific system is installed, that material compatibility has been reviewed, and that there are no sequencing issues that would prevent the assembly from being installed as intended.
4. Site visits at initial installation of the roofing system verify if the air barrier and insulation are properly installed or if adjustments need to be made to subsequent installations.
5. Verification through testing or infrared scanning can confirm if the installation was successful or help to

identify continuity issues before they become a problem for the building owner.

Conclusion

The BECx process helps project teams prevent problems through proactive quality-control activities, such as peer review of design documents and contractor submittals. It also verifies enclosure performance through field testing and mock-up installations. The issues logs, reports, and documentation generated during the BECx process support long-term facility operation and maintenance. By connecting design review, construction oversight, and performance verification, the BECx process helps ensure the building enclosure meets the owner's objectives and performs as intended throughout the building's life.

As building enclosure systems grow more complex and energy performance requirements continue to expand, project teams must decide whether they will address enclosure performance proactively during design and construction or respond to failures after the building has been completed.

Considerations for the future of BECx

- Increased energy code airtightness requirements—Energy codes, including 2021 and 2024 *IECC* and local energy stretch codes, now require whole building air leakage testing or design and construction verification. This will likely push BECx teams to play a larger role in developing testing specifications for code compliance, coordinating air barrier systems, verifying continuity during construction, and preparing projects for air tightness testing.
- Thermal modeling and digital design—Future BECx processes may integrate digital modeling tools earlier in design to identify risks before construction. Hygrothermal modeling tools such as Wärme Und Feuchte Instationär (WUFI) and computational fluid dynamics (CFD), along with thermal bridge modeling tools such as THERM, enable project teams to evaluate potential enclosure performance issues early in the design phase. 3D modeling tools, such as building information modeling (BIM), improve design coordination of enclosure transitions and help construction teams better understand trade sequencing.
- Greater owner and industry awareness of commissioning—Large institutional owners, including healthcare systems, universities, and government agencies, increasingly require BECx in project specifications. Sustainability programs such as LEED and the WELL Building Standard reinforce their importance by incorporating commissioning credits. As adoption grows, BECx continues to shift from a best practice to an industry standard expectation.
- Standardization of BECx guidelines—Industry guidelines from organizations such as ASHRAE, NIBS, and ASTM continue to evolve and will likely drive more consistent BECx scope definitions and documentation requirements.
- Expanded role in long-term performance verification and resilience—Climate events, moisture risks, and durability concerns are driving owners to prioritize long-term building resilience and measurable performance outcomes. BECx will likely play a larger role in verifying water management, thermal continuity, and condensation risk, and may expand to include thermal performance validation, moisture monitoring, and long-term enclosure performance tracking.

additional information

AUTHOR

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KEY TAKEAWAYS

Building enclosure commissioning (BECx) is a specialized third-party quality assurance process that verifies a building's shell meets specific performance requirements. By identifying design gaps and installation errors early, BECx mitigates long-term risks associated with water penetration, thermal performance, and moisture management.

MASTERFORMAT NO.

01 91 19—Building Enclosure Commissioning Requirements

UNIFORMAT NO.

B20—Exterior Enclosure

KEYWORDS

Division 01
Building enclosure commissioning (BECx)
Building enclosure
Enclosure commissioning
LEED
Project outcome

Low Carbon, High Coordination

Designing MEP Systems in Mass Timber Buildings

By Robin Graves, PE, LEED AP, Jessica Mangler, PE, and Brett McQuillan, PE

PHOTO COURTESY MCKINSTRY

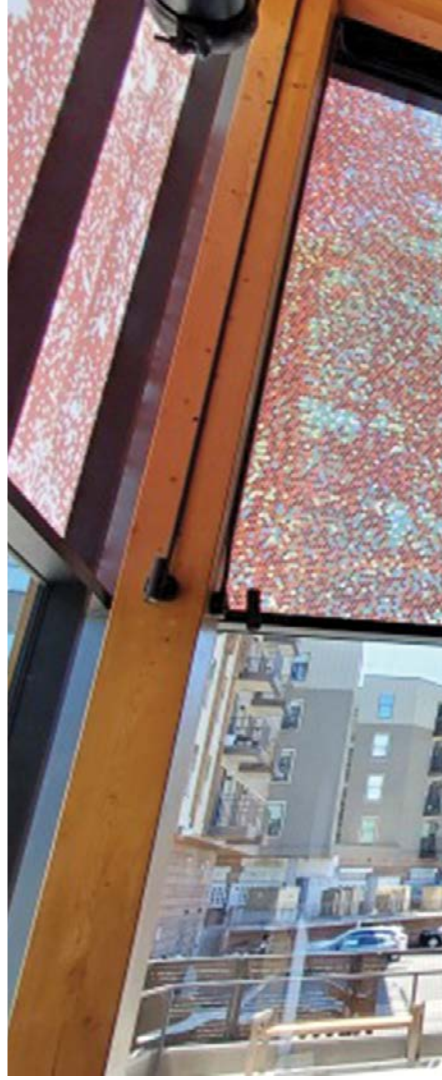
Mass timber has emerged as a leading material in the pursuit of low-carbon, sustainable construction. With its warm, natural aesthetic and significantly lower embodied carbon than steel and concrete, mass timber is increasingly used across a wide range of building types. However, unlike conventional steel or concrete structures, the very characteristics that make it appealing also create unique challenges.

The constraints of mass timber construction, such as exposed structural elements and prefabricated panels with limited flexibility, demand a new level of precision and foresight in the design and coordination of mechanical, electrical, and plumbing (MEP) systems. By anticipating the structural and aesthetic challenges of mass timber and engaging in thoughtful MEP design and coordination, engineers, architects, and specifiers can deliver high-performance buildings that not only celebrate the beauty of timber but also help meet decarbonization and sustainability goals.

Advantages of mass timber

Over the past decade, as the construction industry has favored sustainable and innovative building methods, mass timber has become a popular alternative to traditional materials. By layering and connecting wood elements with fasteners such as adhesives, nails, or

Oregon State University's Jen-Hsun Huang and Lori Mills Huang Collaborative Innovation Complex utilized a vertical, prefabricated multi-trade rack for the mass timber structure's ductwork and piping, which eliminated weeks of potentially hazardous on-site labor.
PHOTO COURTESY MCKINSTRY

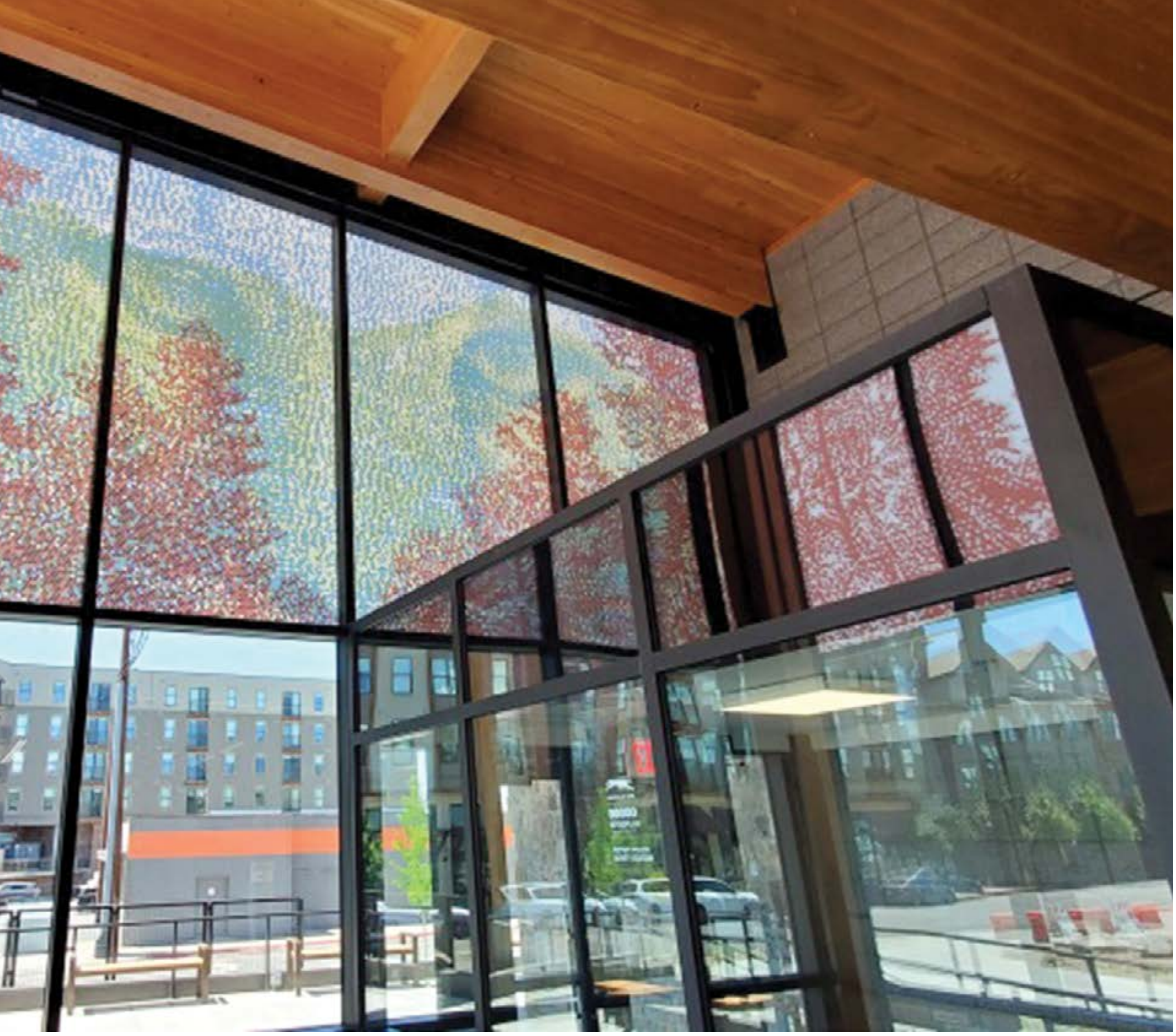


dowels, mass timber components demonstrate exceptional strength and load-bearing capacity. They exhibit excellent rigidity and dimensional stability, comparable to steel and concrete, as well as superior fire, seismic, and thermal performance.

Given these qualities, mass timber is suitable for a variety of structural applications, including beams and columns; floor, roof, and wall panels; tall wall framing studs or roof rafters; and door and window headers. At the same time, mass timber is lightweight and versatile enough for a wide range of architectural styles. Cross-laminated timber (CLT), for example, is the most well-known and widely used structural material for major building elements, such as floors, roofs, and walls. In contrast, glue-laminated timber (Glulam) can be shaped into complex, curving forms ideal for use in innovative, modern architecture where the natural beauty of wood is meant to be highlighted.

While mass timber's strength and versatility offer distinct advantages, its aesthetic appeal is a major factor driving its growing popularity. The warm, natural look of exposed wood creates a sense of harmony with the environment, resulting in visually striking spaces. When paired with biophilic design—an approach that integrates natural elements, lighting, and materials into the built environment—mass timber can strengthen occupants' connection to nature, reducing stress and anxiety while enhancing health, well-being, and productivity.

Environmental benefits are another major reason for the growing interest in mass timber, as more organizations and facilities aim to reduce their carbon emissions and meet their sustainability goals. Mass timber generally has lower embodied carbon than steel and concrete, as its manufacturing and transportation use less energy and produce fewer emissions. Also, the wood in mass timber products, which comes from smaller trees, lower-quality lumber, and waste pieces, stores more carbon than it releases over its lifespan. It generates less waste than other building materials, and its strength and durability make it well-suited for deconstruction and reuse projects.



Mountain Line Downtown Connection Center's high-performance facade, enhanced by Haddad Drugan's artwork, *Lion Eyes (Through the Forest)*, allows the maximum potential for daylighting and a more engaging space.

PHOTO COURTESY AFFILIATED ENGINEERS, INC.

Structural and material factors in MEP design

While mass timber offers numerous benefits and opportunities for innovative design, its fabrication and associated construction processes introduce complexities that affect MEP coordination. Mass timber presents unique challenges that necessitate more precise planning for the effective integration of MEP systems, particularly in areas such as adjustability, acoustics, and humidification.

Panel modifications and penetrations

Mass timber products are typically custom-designed for each job, and components must be fabricated off-site to meet exact specifications for each project location. Therefore, mass timber panels have limited flexibility for on-site modification, making it challenging and time-consuming to drill, cut, or alter them on-site.

Major MEP systems and components must be fully coordinated during preconstruction before ordering panels from the supplier. Additionally, all penetrations should be carefully planned, minimally invasive, and coordinated with structural and fire protection consultants. This ensures precise cutting of penetrations during panel fabrication, resulting in more accurate opening dimensions and a cleaner appearance.

Creating openings in a mass timber floor or roof panel may affect the assembly's fire resistance and acoustic performance. To preserve the integrity of fire-rated assemblies, all penetrations should be properly sealed and protected in accordance with the *International Building Code* (*IBC*) or the locally adopted and amended version of this code in the jurisdiction of the project.

Sound attenuation

Acoustics significantly impact occupant comfort, particularly in open-plan or high-volume spaces. The absence of an acoustical ceiling tile or gypsum ceilings in mass timber buildings can amplify sound, making it crucial to integrate acoustic treatments through system design, material selection, or spatial planning. Coordinating acoustic criteria and associated requirements is essential to meet desired sound levels. Mass

Mountain Line Downtown Connection Center's exposed fresh air ductwork and piping systems are color-coordinated and thoughtfully aligned through beam penetrations, complementing the architectural language.
PHOTO COURTESY AFFILIATED ENGINEERS, INC.

timber inherently has more exposed solid surfaces than traditional materials, so it is important to explore additional sound-absorbent surfaces.

Multiple sound-reduction solutions can be incorporated early in the design process to address sound concerns. For example, dowel laminated timber (DLT) can have milled voids filled with acoustic insulation between the laminations to enhance sound absorption. If needed, a similar effect can be achieved by removing sections of wood to create return/exhaust air pathways. This is ideal for atrium smoke exhaust systems that require a large volume of air and a large grille in a highly visible space.

To mitigate noise from mechanical systems, engineers often specify lined ductwork with internal acoustic insulation, which helps absorb sound generated by airflow and equipment. Sound attenuators, strategically placed near fans or terminal units, further reduce noise propagation throughout the ductwork system.

Moisture control

While mass timber can safely absorb some moisture, there are risks if the wood cannot dry properly or if water becomes trapped at interfaces, such as beneath concrete floor toppings or roofing membranes. Prolonged exposure to high humidity or repeated wetting and drying cycles can put additional stress on structural attachments and fasteners, lead to decay and structural damage, and cause the growth of fungi and bacteria on and within the wood.

Mechanical systems should be designed to maintain an acceptable humidity range, protecting the structure by minimizing expansion and contraction. In dry climates, a relative humidity (RH) of 20 to 30 percent is recommended, with a maximum of around 50 percent. Maintaining these humidity ranges helps prevent dimensional changes in the wood and preserve the investment and aesthetics of the timber.

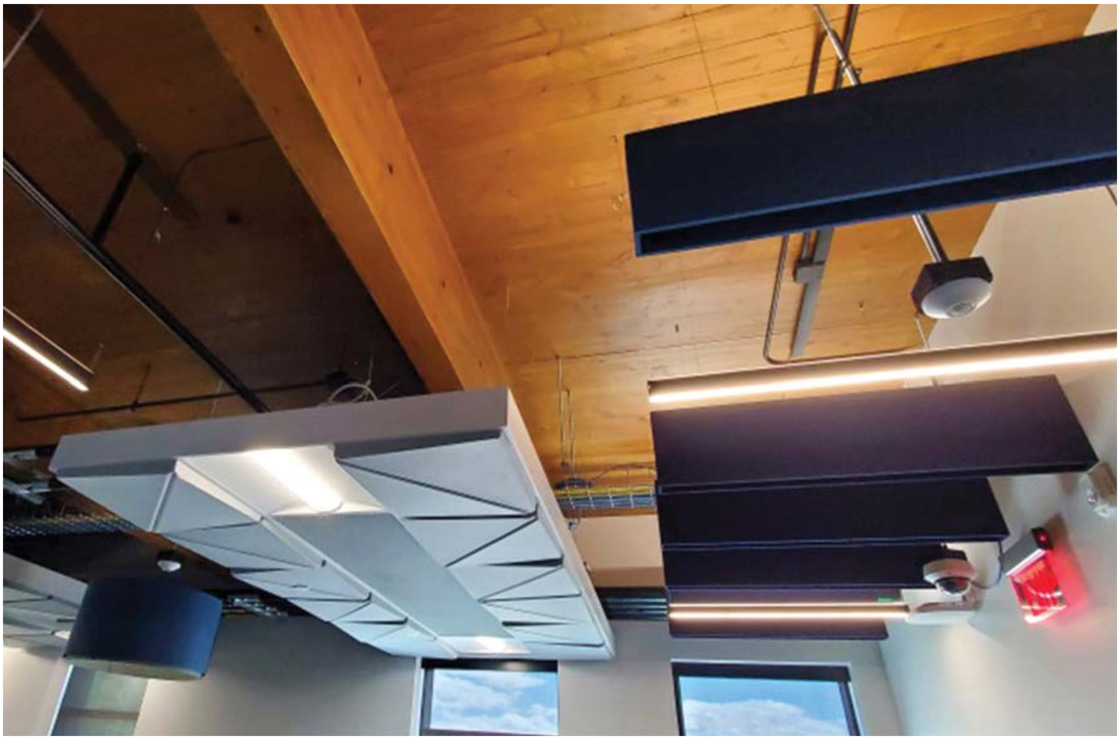
Designing MEP for aesthetic appeal

A defining feature of mass timber architecture is the visibility of its structure, making the visual integration of MEP systems critical. Exposed wood surfaces create a warm, tactile environment, but leave little room to hide ductwork, piping, fire sprinklers, conduits, and other components.

In some cases, exposing systems can complement the architectural language when carefully aligned, color-coordinated, and thoughtfully detailed. In other instances, concealment strategies such as soffits, millwork, or raised floors are more appropriate. The key is to treat MEP systems as design elements rather than afterthoughts.

To better integrate ductwork, piping, and conduit layouts into the architectural design, horizontal branches and mains can be aligned with beams and corridors. Ideally, mains are concealed behind deep beams in primary sightlines, such as main entrances. Reducing the use of elbows, offsets, and reducers maintains a clean, organized appearance.

An efficient layout should provide sufficient vertical and horizontal space for utilities to follow main routes and branch off without needing offsets to navigate around other trades.



Mountain Line Downtown Connections Center's exposed chilled beams and acoustic treatments maintain optimal comfort levels.

Developing trade zoning details early to identify where each system will go through main corridors is essential for creating a streamlined design. Including sections and zoning details of key areas in the bid documents will ensure the design intent is followed in the field.

Concealed spaces, such as dropped ceilings, soffits, or chases, provide additional options for routing MEP components. Specifically, raised concrete-tile floors supported on pedestals are ideal for mass timber projects. Supply air, piping, electrical conduits, and technology cable trays can use the raised floor cavity to serve open office spaces without overhead drops. Note that return air grilles, fire protection, wireless access points, fire alarms, and lighting conduits will remain exposed at ceiling level.

Embracing sustainable MEP solutions

One of the main appeals of mass timber is its ability to sequester carbon and reduce greenhouse gas emissions. The unique architectural features also naturally support low-carbon, sustainable mechanical solutions. Ultra-efficient MEP design leverages the low-carbon qualities of mass timber, saving energy costs and reducing operational carbon emissions. They also ease coordination challenges from open ceilings and deeper beams that conventional overhead systems often struggle with.

When it comes to lighting, high-volume spaces without conventional dropped ceilings are prime candidates for dynamic daylighting strategies, including clerestories and skylights. Open ceiling volumes allow maximum daylight deep into a building, reducing reliance on electrical lighting. The added surface area of the timber beams allows indirect lighting to provide more diffused, reflected light throughout a space. In contrast, the vertical surfaces add a dynamic element to overhead lighting, creating a more engaging space. Lighting control systems must account for the higher ceiling volumes, including thoughtful placement of daylight-harvesting photocells.

Radiant floor systems or displacement ventilation systems along the floor are particularly efficient in taller volumes and synergize well with mass timber's tendency to reduce ceiling distribution. Floor-based heating and cooling systems maintain optimal comfort in the lower portion of the space and allow higher temperatures in the upper portion, resulting in a net reduction in heating and cooling requirements.

In climates with consistently warmer outdoor temperatures, floor heating and cooling systems work well alongside outdoor economizer systems (free cooling) because they can elevate return air temperatures at the top of high-volume spaces. When optimally designed, these systems are among the quieter options for space conditions, which suits mass timbers' reduced capacity for noise attenuation.

For example, the high-performance heating and cooling system at Mountain Line Downtown Connection Center in Flagstaff, Ariz., uses all-electric, grade-level central heat pumps to distribute hot and chilled water throughout the building's radiant floor system and overhead active and passive chilled beams. With these beams, the overhead fresh-air ductwork and piping were reduced and carefully coordinated through beam penetrations as needed.

Early coordination and careful integration are key

As mass timber continues to gain traction in the built environment, the importance of thoughtful MEP integration cannot be overstated. Integrated design and early collaboration between disciplines are essential for successful planning and coordination. Bringing MEP engineers into the conversation from the earliest conceptual stages allows for more efficient system layouts and fewer conflicts. For complex buildings where MEP systems are more exposed and put on display, the need for this iterative design and coordination process is even more critical.

Also important is coordination with timber fabricators, architects, and the construction team. Panel layouts, beam depths, and connection details all influence how and where systems can be routed. By working directly with manufacturers, engineers can align system needs with structural realities, reducing the need for costly redesigns or field modifications. This can help avoid late-stage routing changes or overlooked penetrations, save time, reduce costs, and preserve the architectural integrity of the timber structure.

Ultimately, successful MEP integration in mass timber buildings requires a balance of technical rigor and design sensitivity. When done well, it enhances both performance and aesthetics, reinforcing the project's holistic sustainability goals.

additional information

AUTHORS

Robin Graves, PE, LEED AP, is a principal at Affiliated Engineers, Inc., bringing more than 20 years of experience in designing mechanical systems that balance innovative design, performance, and aesthetic appeal. She has led teams on a variety of projects, including cleanrooms, laboratories, pharmaceutical manufacturing, industrial facilities, and higher education institutions, utilizing her diverse system and project expertise to help clients meet their goals.

Jessica Mangler, PE, is a principal and project manager at Affiliated Engineers, Inc., with more than 15 years of experience designing mechanical systems for complex, high-performance buildings. Her portfolio includes research laboratories, BSL-3 facilities, data centers, supercomputing environments, and semiconductor cleanrooms. She brings deep expertise in energy-efficient ventilation design, decarbonization strategies, decoupled cooling, chilled beam systems, radiant heating and cooling, and high-performance heat recovery solutions. She regularly leads multidisciplinary teams on technically demanding, fast-paced projects across the higher education, science and technology, and healthcare sectors.

Brett McQuillan, PE, is a principal at Affiliated Engineers, Inc., with more than 10 years of experience in analyzing, engineering, and designing mechanical systems for laboratories, healthcare, and higher education spaces. He offers design leadership through building performance simulation, generating integrated solutions that focus on innovative carbon, energy, and water conservation efforts for zero-net-energy, carbon-neutral, and multiple LEED Platinum-certified projects.

KEY TAKEAWAYS

Mass timber's prefabricated nature and exposed aesthetics require precise, early-stage coordination among mechanical, electrical, and plumbing (MEP) systems. Designers must integrate technical systems—such as acoustic treatments and moisture controls—as visual elements to preserve the building's biophilic appeal and structural integrity.

MASTERFORMAT NO.

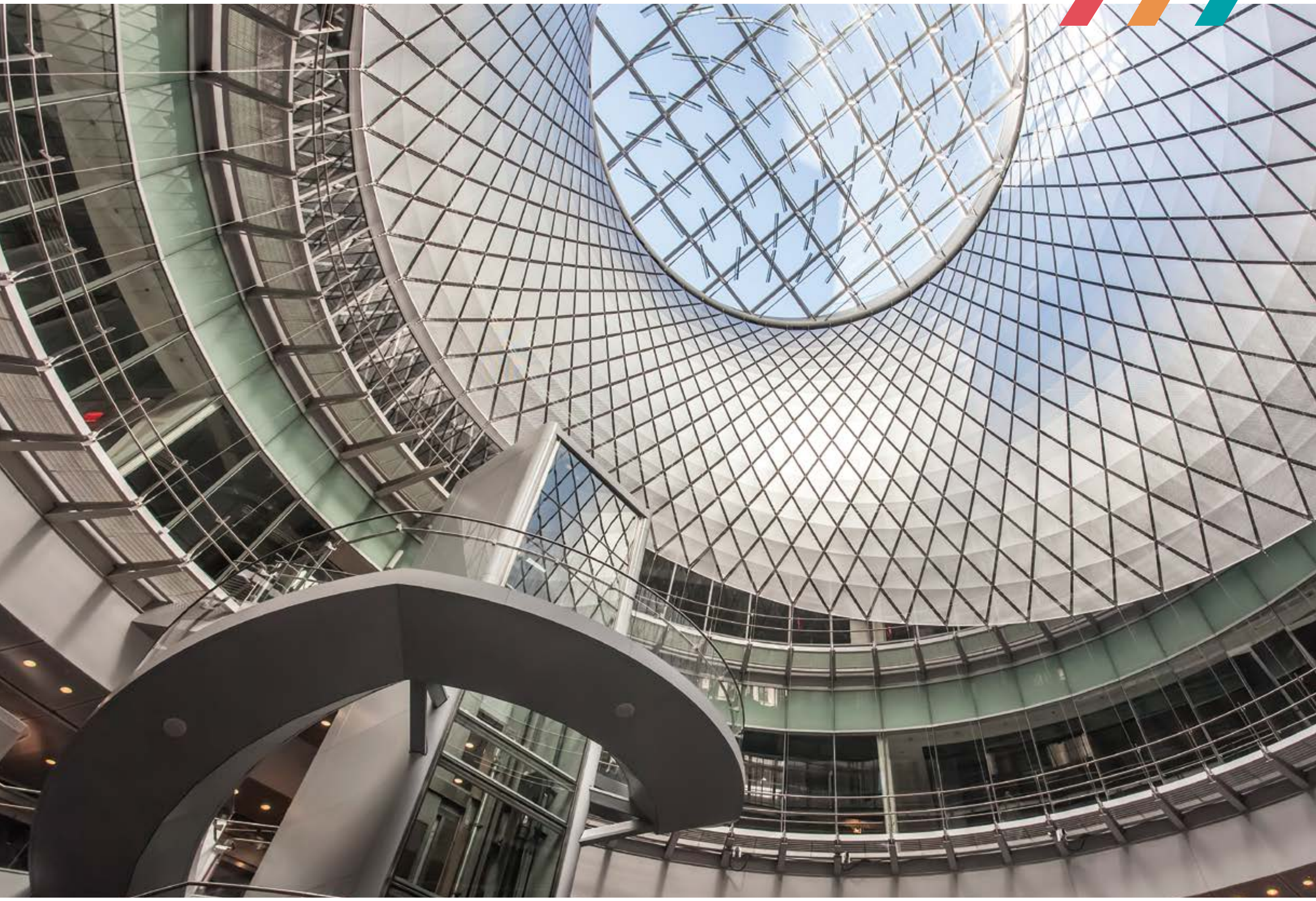
06 18 00–Mass Timber Construction
21 00 00–Fire Suppression
22 00 00–Plumbing
23 00 00–Heating, Ventilating, and Air Conditioning (HVAC)

UNIFORMAT NO.

B10–Superstructure
D30–Heating, Ventilation, and Air Conditioning (HVAC)
D40–Fire Protection
D50–Electrical

KEYWORDS

Division 06, 21, 22, 23
Decarbonization
Mass timber
Mechanical, electrical, and plumbing (MEP) coordination



Planes, Trains, and Glass

Using Glazing in Transit Hubs

By Devin Bowman

PHOTO COURTESY TECHNICAL GLASS PRODUCTS (TGP)

Despite being intermediate steps into a journey from one place to another, transit hubs, such as airports and metro stations, can drastically shape the first impression a traveler has of their destination. These hubs can also improve the experience with intuitive wayfinding and ample daylighting. Further, the design of these spaces can positively impact the mental well-being of many employees for many of the same reasons.

However, unlike other projects, these built environments are often subject to increased security and traffic control considerations. Additionally, for public transit hubs in densely populated cities, fire- and life-safety code requirements, such as the *International Building Code* (*IBC*), National Fire Protection Association's (NFPA) Life Safety Code NFPA 101, and other local safety codes, may also influence the type of glass used in a project.

While there are several functional benefits from the extensive use of transparent glass in airports, train stations, and metro stops, advanced glazing assemblies also create aesthetically pleasing environments, elevating the experience of the thousands of visitors they serve every day.

More specifically, glass curtain walls can transform these high-traffic public spaces into light-filled, visually engaging, and passenger-friendly environments. Oklahoma City's Will Rogers World Airport and New York City's Fulton Transit Center offer prime examples of how both the glass and the framing components work together to marry form and function in transit hubs.

Above: Roll-formed steel offers fire ratings while maintaining aesthetic cohesion between fire-rated and non-rated assemblies.

PHOTO COURTESY TECHNICAL GLASS PRODUCTS (TGP)

Right: Steel's strength allows expansive curtain walls and large spans within Will Rogers World Airport.

IMAGE BY SIMON HURST PHOTOGRAPHY

Airport uses transparent glazing throughout

In 2021, Will Rogers World Airport officials sought to improve security checkpoints, create several new retail experiences, and enhance the airport's visual appeal by expanding its east concourse. Central to many of these goals were three massive glass curtain walls spanning heights of more than 10.1 m (33 ft). These four-sided, structurally glazed curtain wall assemblies were specified along the facade and within the building. They allow intuitive, secure movement from passenger drop-off areas to the gates while facilitating a flat, monolithic, and continuous glass appearance.

They also allow substantial daylight to stream into the airport through their wide expanses of uninterrupted glass, with some lights measuring more than 2.1 m (7 ft) wide and nearly 3.6 m (12 ft) tall.

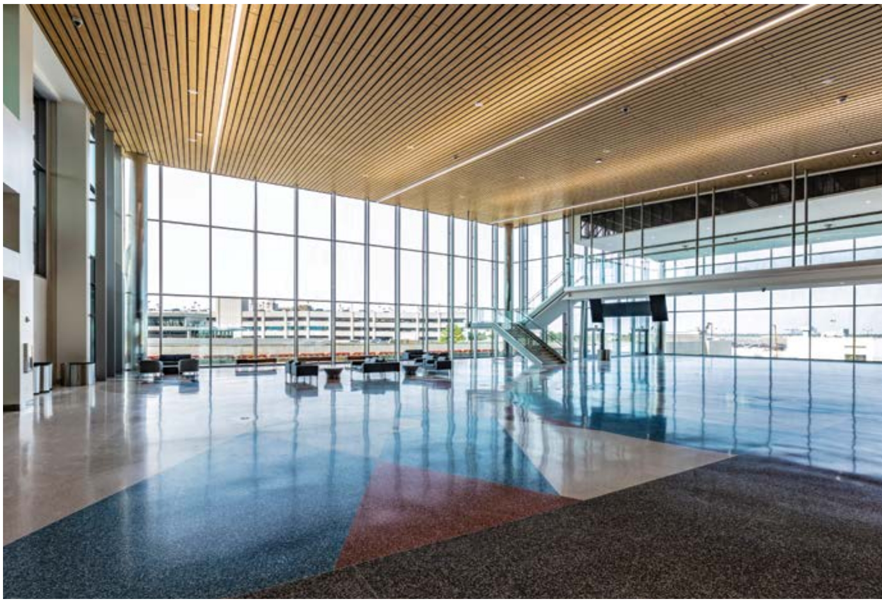
In addition to its size, the exterior curtain wall incorporates a unique concave bow that follows the terminal's profile and drops below the interior floor line, giving it the appearance of floating. The exterior curtain wall system leverages a stainless-steel frame anchored to another steel system that is a part of the building's structure. Both aspects of the curtain wall allow it to scale its impressive height and width without increasing mullion density. Without increased framing and support systems, the curtain wall's large spans of unobstructed glazing provide greater access to natural light.

This natural light deeply penetrates the airport's interior through the two glass curtain walls at the concourse's security checkpoint. These glass barriers help to regulate the flow of passengers into the concourse without blocking daylight or sacrificing the visual connection between the two spaces, which can be key to creating an easily navigable space. Together, all three curtain walls strike a balance between necessary pre-flight precautions and an open design that allows passengers to see the next step in their journey.

Steel's material potential enables multiple design goals

At Will Rogers World Airport, the three curtain wall systems do more than enable an open, transparent design. They also support multiple goals to enhance the comfort of travelers and employees. For instance, the low-emissivity (low-e) glazing units used in the curtain walls improve daylight access while minimizing solar heat gain. The assemblies' steel framing systems support these large spans of high-performance glazing while significantly contributing to meeting design goals.

To make this possible, steel has nearly three times the inherent strength of aluminum, as determined by the tensile test ASTM E8, *Standard Test Methods for Tension Testing of Metallic Materials*. This allows curtain walls to be larger without increasing mullion size or number. For example, according to ASTM E330, *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*, an



Steel supports the concave bow and soaring heights of this exterior curtain wall system.

MAGE BY SIMON HURST PHOTOGRAPHY

aluminum mullion measuring 63.5 x 190.5 mm (2.5 x 7.5 in.) with a 1.52 m (5 ft) mullion spacing at a 146.5-kg/m^2 (30-lb/sf) wind load can span up to 3.8 m (12.5 ft), including the glass and exterior cap. A similarly sized steel profile measuring 61 x 193 mm (2.4 x 7.6 in.) would deflect only one-third as much as aluminum under the same test standard conditions, allowing a span of 5.2 m (17 ft) before exceeding its deflection capacity.

At Will Rogers World Airport, a stronger framing system, combined with the building's structural components, enabled the exterior curtain wall to maximize glazing areas and minimize framing materials across its 10 m (33 ft) height and 26.8 m (88 ft) width. From a design perspective, this improved access to daylight and visual connection throughout the concourse. From an installation perspective, reducing framing reinforcement requirements and streamlining the anchoring system enabled the team to tackle the project efficiently.

Finally, steel's low thermal conductivity supports efficient operation. The material's conductivity is about 74 percent lower than aluminum (approximately 32,707 J/hr (31 Btu/hr) vs. 124,497 J/hr (118 Btus/hr), meaning steel framing heats and cools at slower rates than comparable aluminum systems. This also supports the glazing's ability to provide daylight and a comfortable indoor atmosphere by reducing thermal bridging, improving overall efficiency. Further, it can be crucial when a system needs a fire rating.

Steel connects fire-rated and non-fire-rated assemblies

Although none of the curtain walls at Will Rogers World Airport required a fire rating, many transit hubs require building components to meet fire and life-safety requirements. In these instances, fire-rated glazing can help project teams ensure occupant safety while delivering an open and cohesive design. Fire-rated glazing provides utility and versatility for code-compliant fire-rated doors, wall panels, and curtain walls. It achieves fire-resistance ratings across full assemblies without compromising design cohesion.

This is partially due to the material's strength. Depending on its rating, fire-rated glass can be nearly four times as heavy as architectural glass. To compensate for the added weight, framing systems may need to increase profile dimensions and/or reduce mullion spacing. Cold-formed fire-rated steel framing combines the material's strength with a manufacturing process that yields slender profiles closer to those of non-rated frames. In turn, these fire-rated assemblies can be used in stairways, elevator shafts, and any other location where fire-rated and non-rated assemblies will be installed in proximity without creating glaring discrepancies between them.

Steel's strength also works with its higher melting point—depending on the steel alloy, 1,371 to 1,538 C (2,500 to 2,800 F), compared to aluminum, which melts at approximately 660 C

Above: Steel's inherent strength allows tall curtain walls and wide spans without the need for secondary structural supports.

IMAGE BY SIMON HURST PHOTOGRAPHY

Right: High strength and a high melting point help ensure this elevator shaft will remain safe in the event of a fire.

PHOTO COURTESY TECHNICAL GLASS PRODUCTS (TGP)

(1,220 F). This helps project teams design enclosures that can handle both the added weight of fire-rated glass and the risk of deformation and failure these systems must withstand during a fire.

Fulton Center blends glazing in NYC Transit Hub

The combination of performance and aesthetic possibilities offered by fire-rated steel framing helped the design team behind the Fulton Center create a light-filled, visually coherent, and code-compliant structure for those who live and visit New York City.

Construction began in 2005 and wrapped in 2014, creating a light-filled, open space—the Fulton Center now serves as more than just a stop for its more than 300,000 daily commuters. Most of the natural light in the transit hub comes from a massive glass oculus that makes up the bulk of the building's roof, and a functional art installation called *Sky Reflector Net Light.* travels from these elements deep into the two-level enclosed space below it.

This circular, mixed-use environment was glazed to minimize light obstructions and enhance a more intuitive transit center. In addition to the complexities of its distinctive shape, the design team aimed to create a cohesive aesthetic between the fire-rated curtain walls on the upper level and the prominent elevator core, and the non-fire-rated curtain wall system on the lower level. These goals were achieved by using fire-rated steel framing with a high degree of strength within its narrow profiles.

The use of the same manufacturing method for fire-rated frames with steel back members allows the fire-rated curtain wall to match the slender frame profiles of the non-rated system below. Stressing the importance of clean sightlines, Andrew Anderson, associate principal, Grimshaw Architects, the firm behind the project, explains that the minimal framing details were "easy enough" to achieve with non-rated curtain wall assemblies, yet the fire-rated curtain walls provide the same crisp, modern look.

The fire-rated frames were made of heat-resistant carbon steel that could be roll-formed into profiles as narrow as 44.5 mm (1.75 in.) and featured precise, crisp edges. Spanning around 3 m (10 ft) high, the fire-rated frames visually matched the non-rated framing systems. The main elevator shaft underscored this match by physically and visually connecting the two assembly types.

Curtain wall design starts with material potential

As these two projects show, the design of a transit hub, whether for subways, airplanes, or buses, often has complex requirements and goals. In terms of facilitating daylight access and openness, steel-framed glass curtain walls offer several distinct advantages.

The frame strength allows greater spans between mullions, increasing glazing area, even

Allowing stainless steel cover caps without significantly increasing frame dimension, roll-formed steel framing eases maintenance requirements for this transit hub.

PHOTO COURTESY TECHNICAL GLASS PRODUCTS (TGP)

when a system must accommodate the added weight of fire-rated glass or other high-performance glazing. When manufactured using cold-forming techniques, it can also achieve profile dimensions closely resembling those of non-rated systems, resulting in a more cohesive design aesthetic.

Steel's low thermal conductivity, high melting point, and compliance with fire-resistance rating requirements for curtain walls further enhance its versatility in transit hubs. Although not specific to these projects, stainless steel alloy frames can also enhance design flexibility and durability while streamlining cleaning requirements for exterior-facing applications.

With their versatility, steel-framed curtain walls increase the design freedom of project teams when planning airports, metro stations, and transit hubs—all without compromising functionality or building code compliance. This enables designers to address challenges in improving these spaces, both in terms of operational efficiency and in their ability to support occupant well-being through daylight access. As such, specifiers are encouraged to consider steel framing systems when planning glazing assemblies in transit hubs. Doing so can help improve the performance of these systems without compromising aesthetic goals.

additional information

AUTHOR

Devin Bowman is general manager of Technical Glass Products (TGP) and AD Systems. With more than 20 years of industry experience, Bowman is actively involved in advancing fire- and life-safety codes and sits on the Glazing Industry Code Committee (GICC). He can be reached by email at devin.bowman@allegion.com or at (800) 426-0279.

KEY TAKEAWAYS

Advanced steel-framed glass curtain walls enhance transit hubs like Oklahoma City's Will Rogers World Airport and New York's Fulton Center. Steel's superior strength and thermal properties enable expansive glazing, improving daylighting and navigation while seamlessly integrating essential fire-safety and security requirements into the design.

MASTERFORMAT NO.

08 44 13–Glazed Aluminum Curtain Walls
08 44 23–Structural Glass Curtain Walls

UNIFORMAT NO.

B2020.50—Curtain Wall

KEYWORDS

Division 08
Steel-framed glazing
Daylighting
Fire-code safety

Impacts on Roof Loading Due to Snow Drifting

According to the *International Building Code* (*IBC*) and legacy codes, snow loads must be considered in the design of buildings in areas prone to snowfall. These model building codes refer to the American Society of Civil Engineers (ASCE) Standard 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, for detailed requirements for designing building structures for snow loads.

New buildings are designed for evenly distributed flat or sloped roof snow loads, with additional consideration for snow drifting and unbalanced loads based on roof size and shape. Changes to roof geometry of existing buildings can alter snow load distribution, which is particularly relevant for structures built before the late 1970s, when snow drift load requirements were not explicitly included in standards, such as ASCE 7.

Snow drifting on roofs occurs when wind carries snow from one roof area to another, creating larger accumulations and higher loads than a typical uniformly distributed snow load. Snow can drift against obstacles such as parapet walls, rising walls, higher roof sections or steps, and rooftop mechanical equipment. The unobstructed horizontal roof area that contributes to a snow drift is known as the fetch; the longer the fetch, the more snow available to form the drift.

Unbalanced snow loads are an uneven distribution of snow on a roof caused by wind-driven redistribution. A common example is snow being blown from one slope of a gable roof to the opposite slope, causing an uneven loading condition.

When additions or geometric modifications are made to an existing building, careful consideration must be given to how they may affect snow load distribution on the existing roof, including the potential for new or larger snow drifts and unbalanced snow loads. For example, an addition could create a longer fetch, allowing more snow to accumulate against an existing roof height transition, rising wall, or mechanical unit. Similarly, a new rooftop mechanical unit or rising wall for a higher roof can create a new obstruction where drifting may occur. If these changes increase roof snow loads, the existing structural system should be evaluated in accordance with the applicable provisions of the International Existing Building Code (IEBC) or local jurisdiction requirements, and existing structural elements should be strengthened or supplemented as necessary.

It should also be noted that more recent versions of ASCE 7 require snow drifting to be considered for adjacent buildings having a lower height than a nearby taller building when within a specified proximity of the taller building; this could have implications for the shorter of the buildings during the construction of a new building or addition.

Figure 1

Roof collapse due to snow drift accumulation at the roof height transition.

PHOTO COURTESY WISS, JANNEY, ELSTNER ASSOCIATES

Figure 2

Failed wood truss roof structure due to snow drift accumulation at step in roof height.

PHOTO COURTESY WISS, JANNEY, ELSTNER ASSOCIATES

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