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In this issue:

On the cover:

Designed by Hayes Group Architects, 726 Main Street transforms an 1859 Redwood City landmark into a modern, light-filled office. A 2024 AIA San Mateo Honor Award winner, it features exposed brick, polished concrete, glass, and redwood ceilings—blending historic character with contemporary design.

See the article on adaptive reuse on page 26.

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How I Earned My CCCA: A Conversation with Michelle Bailey, CCCA

The decision to earn a professional certification is not just tactical; it can also be transformative. For Michelle Bailey, attaining CSI's Certified Construction Contract Administrator (CCCA) designation deepened her contract management expertise and elevated her confidence in navigating complex projects.

In this Q&A, Bailey shares her journey—from her decision to work in the architecture, engineering, construction, and owner (AECO) industry to strategies for preparing for the rigorous CCCA exam. She also discusses how earning the certification has refined her project delivery and contract administration approach. Through dedicated study, collaboration with peers, and the support of her professional community, her experience offers valuable insights for those considering certification.

Tell us about your career and why you chose to work in this industry. What made you decide to pursue a CSI certification?

Choosing a career in the AECO industry has been one of the most fulfilling decisions of my life. This industry offers a unique blend of creativity, technical expertise, and problem-solving, aligning perfectly with my interests and skills.

I chose this field because it allows me to participate in projects that shape the built environment and leave a lasting impact on communities. Every project presents new challenges and opportunities to innovate, collaborate with diverse teams, and continuously learn and grow. The dynamic nature of the AECO industry keeps me engaged and motivated.

Overall, my career in the AECO industry is driven by a passion for learning and a desire to make a positive impact. The CCCA certification has advanced my expertise and credibility, allowing me to take on more complex and rewarding projects.

How did you study or prepare for the certification exam?

To prepare for the CCCA certification exam, I utilized various resources and strategies to ensure I was thoroughly prepared. I made extensive use of the CSI materials, the *Certified Construction Contract Administrator (CCCA) Practice Guide*, and the *CCCA Study Workbook*. Having a thorough knowledge of American Institute of Architects (AIA) contract documents and Engineers Joint Contract Document Committee (EJCDC) forms was instrumental. These resources were comprehensive and provided a solid foundation of knowledge.

Additionally, I organized an online study group with some fantastic peers. For each session, a study group member volunteered to lead training sessions tailored to the CCCA certification exam. These study sessions offered valuable insights and practical examples directly applicable to the exam content and knowledge domains. Discussing topics with peers provided new perspectives and clarified doubts I hadn't considered.

My professional and personal community played a crucial role in my success. Colleagues were very supportive, sharing experiences and exam tips. Family and friends were also incredibly encouraging, providing motivation and confidence. A strong support system made a significant difference, especially during moments of self-doubt.

How has earning your certification informed how you approach new projects, especially when developing, administering, and enforcing construction documentation?

Earning a CCCA credential was a strategic decision to advance my career. This CSI certification is highly regarded in the industry and demonstrates a commitment to excellence and professionalism. It has given me a deeper understanding of construction documentation, specifications, and project delivery methods. This knowledge enhances my ability to manage projects effectively and contributes to higher standards of quality and efficiency in my projects.

The Spring CSI Certification cycle closes on May 8, and the Fall cycle opens on August 12. Learn more about each certification and register here: **csiresources.org/certification.**

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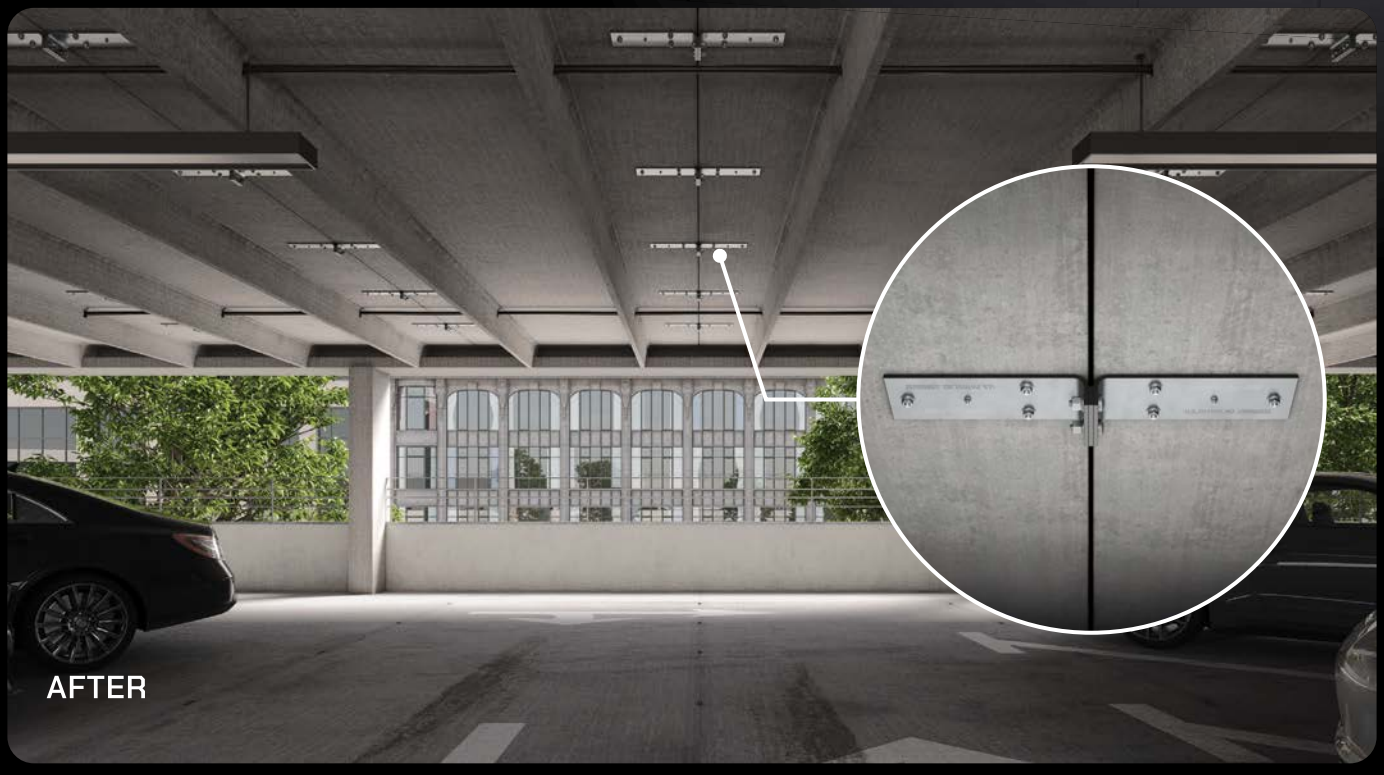

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From LEED to WELL

Certifying Healthy, Resilient, and Sustainable Buildings

By Alan Scott, FAIA, LEED Fellow, LEED AP BD+C, O+M, WELL AP, CEM

PHOTOS COURTESY INTERTEK

The priorities guiding today's construction industry extend beyond traditional structural integrity and visual appeal. The focus now includes how well a building serves its occupants and the environment, especially in the face of increasing climate challenges. Engineers, architects, and specifiers are under growing pressure to design and deliver spaces that prioritize sustainability, occupant well-being, and resilience. At the forefront of this transformation are frameworks such as LEED, the WELL Building Standard, and property resilience assessments (PRAs), which help guide and certify projects that meet elevated benchmarks of environmental responsibility, health-centered design, and climate adaptability.

Integrating sustainability and health with LEED and WELL

The U.S. Green Building Council's LEED certification has long been recognized as the standard for sustainable building practices. LEED promotes strategies that reduce energy and water use, minimize waste, and lower greenhouse gas (GHG) emissions, all while improving indoor environmental quality. Incorporating resilient and sustainable features can also help reduce long-term operational risks and improve a building's value.

Complementing LEED is the WELL Building Standard, administered by the International WELL Building Institute. While LEED focuses mainly on the building's environmental footprint, WELL zeroes in on the people inside. WELL-certified buildings are designed to support and improve the health, comfort, and performance of their occupants. This includes attention to air and water quality, illumination, nourishment, fitness, thermal comfort, and acoustics.

As building occupants seek healthier indoor environments, particularly after the COVID-19

ABOVE: A roof uses vegetation to manage stormwater, improve insulation, and reduce the urban heat island effect. It supports LEED strategies for site development, thermal comfort, and long-term building performance.

BELOW: Flexible meeting areas within open offices help teams connect while supporting overall productivity. Acoustic zoning and material choices can reduce noise disruptions in these collaborative environments.

pandemic, standards such as WELL have become essential tools in the designer's toolkit. WELL provides a measurable and science-backed framework for implementing design and operational strategies that directly affect the physical and mental health of occupants.

Why indoor air quality matters more than ever

Perhaps no building feature has drawn as much attention in recent years as indoor air quality (IAQ). The COVID-19 pandemic heightened awareness of how airborne contaminants can affect our health. As a result, IAQ has become a critical design and operational consideration, especially in high-traffic and high-vulnerability settings such as schools, offices, and healthcare facilities.

A building that prioritizes clean, healthy air not only supports the immediate health of its users but also improves productivity and reduces absenteeism. IAQ criteria under the WELL Building Standard focus on comprehensive filtration strategies, effective ventilation design, humidity control, and the elimination or reduction of indoor pollutants such as volatile organic compounds (VOCs), particulate matter (PM2.5 and PM10), ozone, carbon monoxide, and CO2.

Specifiers and architects should consider the integration of HVAC systems that exceed ASHRAE 62.1 standards, employ MERV 13 or higher filtration, and offer dedicated outdoor air systems. For WELL certification, Feature A01 requires air filtration systems to meet at least MERV 13 performance and be verified through operational testing. In LEED v4.1, EQ Credit: Enhanced IAQ Strategies provides points for additional particle filtration and CO2 monitoring. Materials and finishes should

ABOVE: Flooding can disrupt operations, damage infrastructure, and put occupants at risk. Assessing site vulnerabilities early in the design process helps teams plan for natural hazards and climate-related threats.

BELOW: Monitoring HVAC system performance in real-time helps teams track air quality and energy use. Mobile tools make it easier to stay on top of system operations and maintain building performance over time.

be selected based on low-emitting certifications, such as GREENGUARD Gold or FloorScore, to minimize VOC contributions. Post-occupancy IAQ testing is often required for WELL certification and recommended for LEED v4.1 EQ credits, to meet thresholds for formaldehyde, PM2.5, PM10, ozone, and TVOCs. In addition, airtight construction and proper commissioning verify that air handling systems operate as designed, maintaining proper air changes per hour and limiting pollutant ingress from adjacent zones.

Water quality is another key IEQ-adjacent concern. Specifiers should incorporate point-of-use filtration systems, select plumbing fixtures that are compliant with NSF/ANSI standards, and plan for regular testing protocols to detect contaminants such as lead, copper, and *Legionella* bacteria. This is particularly important in facilities with vulnerable populations, such as schools and medical buildings.

The role of acoustics in occupant wellness

Another frequently overlooked but equally critical component of occupant well-being is acoustic quality. Poor acoustic environments can lead to chronic stress, reduced productivity, disrupted sleep, and diminished cognitive performance. For design professionals, acoustic planning is an increasingly important metric for both occupant wellness and compliance with WELL certification.

Effective acoustic strategies begin with understanding the building program and associated user needs. For example, schools benefit from low background noise and clear speech intelligibility, while healthcare facilities prioritize patient rest and privacy. Office environments require a balance between collaborative spaces, speech privacy, and concentration zones. ANSI S12.60 recommends maximum background noise

Regular water quality testing helps identify contaminants such as lead, copper, and ***Legionella***, supporting health and safety, especially in schools and healthcare settings.

levels of 35 dBA for classrooms to support speech intelligibility and student engagement. For open offices, WELL recommends a maximum of 50 dBA for ambient noise in collaboration zones and 40 dBA in focus areas.

Specifiers should reference standards such as ANSI S12.60 for classrooms and the WELL Sound concept performance metrics to address these needs. Design approaches may include:

- Using resilient underlayments and acoustical ceiling tiles with high noise-reduction coefficient ratings
- Specifying interior partitions with high sound transmission class (STC) values
- Incorporating white noise or sound masking systems in open-plan workspaces
- Planning spatial adjacencies to minimize noise transfer between incompatible uses
- Detailing door and window assemblies to limit flanking paths and infiltration of external noise

Site acoustics also play a role, particularly in urban environments. Landscape buffers, acoustic fencing, and strategic orientation can mitigate external noise sources such as traffic, HVAC units, or nearby industrial operations.

Designing for resilience with PRA

Given the increasing frequency and severity of climate-related events, resilience must be considered a foundational element of building design, not a secondary consideration. Natural disasters, extreme weather, and chronic climate-related stressors can compromise a building's structural and operational integrity. Property resilience assessments are tools designed to evaluate how well a building or development can withstand and recover from such events.

Specifiers and engineers can apply PRA frameworks to identify site-specific vulnerabilities such as flood risk, seismic activity, and extreme temperatures. With this information, they can choose durable materials, incorporate passive survivability into building systems, and help maintain operations before, during, and after disruptive events.

Key design strategies informed by PRAs may include:

- Elevating critical systems and equipment above flood elevation levels
- Using high-wind-rated fenestration systems
- Incorporating redundancy in mechanical and electrical systems
- Designing facades with impact-resistant materials
- Creating thermal envelopes that maintain comfort during power outages

Resilience assessments can also guide the selection of renewable energy sources and battery

Shading devices and high-performance windows help manage sunlight, reduce glare, and support thermal comfort.

QUICK REFERENCE: HEALTHY BUILDING DESIGN CHECKLIST

Indoor air quality (IAQ)

- Use MERV 13+ filters and increase outdoor air ventilation
- Choose low-VOC paints, adhesives, and flooring (GREENGUARD Gold or FloorScore certified)
- Seal building enclosures to reduce infiltration of pollutants
- Design systems to meet or exceed ASHRAE 62.1 for ventilation

Water quality

- Include point-of-use filters for drinking fountains and sinks
- Specify fixtures tested for lead and copper under NSF/ANSI standards
- Plan for ongoing water testing to monitor Legionella and bacteria

Acoustics

- Use high noise reduction coefficient (NRC-rated) ceilings and high sound transmission class (STC-rated) walls
- Plan room adjacencies to reduce noise conflicts
- Add sound masking in open offices
- Follow ANSI S12.60 for classrooms and WELL Sound metrics

Resilience strategies (PRAs)

- Elevate electrical and mechanical systems in flood zones
- Use impact-resistant windows and durable envelope materials
- Design for passive heating and cooling in case of outages. Strategies include thermal massing, operable windows, exterior shading devices, and building orientation to maximize cross ventilation and solar gain management
- Consider solar panels with battery storage for backup power

storage systems, improving energy independence during grid failures. PRA findings can be embedded into the project's risk management plan, ensuring long-term operational stability and protecting occupant welfare.

Integration in practice: A holistic approach

The most successful projects do not treat LEED, WELL, and PRAs as isolated checklists but as integrated components of a unified strategy. By considering environmental sustainability, human health, and resilience from the outset, design teams can create synergistic outcomes that meet or exceed client expectations.

For example, specifying high-performance glazing can reduce energy use (LEED), improve thermal comfort (WELL), and protect against windborne debris (PRA). Selecting low-emission materials addresses both indoor air quality (IAQ) and environmental goals. Acoustic zoning and daylighting strategies can improve wellness while supporting energy efficiency and long-term durability.

Technology and data also play important roles. Intelligent building systems that monitor IAQ, lighting, acoustics, and energy consumption in real time can optimize building performance, support ongoing commissioning, and facilitate compliance with evolving standards.

Moving forward

For engineers, architects, and specifiers, the convergence of sustainability, wellness, and resilience frameworks represents a challenge and an opportunity. Projects are becoming more complex, but the outcomes are more meaningful. Clients across sectors, from education and healthcare to commercial real estate and government, are seeking buildings that offer long-term value through improved performance and user experience.

Professionals should stay current with changes in LEED, including the evolving LEED v5 framework, and the WELL Building Standard rating systems, which reflect a growing industry focus on occupant wellbeing, climate resilience, and environmental justice. LEED v5 introduces a stronger emphasis on decarbonization, equity, and long-term building adaptability, with new performance benchmarks aligned with zero-

emissions goals and climate action priorities. Specifiers should monitor credit changes closely as LEED v5 is finalized, particularly around embodied carbon, electrification, resilience, and social impact. Engaging third-party consultants early in the design phase and coordinating across disciplines helps maintain alignment throughout the design and construction process.

Ultimately, the goal is to build spaces that are beautiful, functional, sustainable, health-promoting, and resilient. By embracing this comprehensive approach, the building industry can lead the way in shaping a better, more thoughtful built environment.

Conclusion

Creating healthy buildings is a practical imperative in today's construction landscape. Architects and specifiers, responding to growing public and client demands for indoor environmental quality, sustainability, and resilience, can use frameworks such as LEED, WELL, and PRAs to elevate project performance, ensure regulatory alignment, and promote human and environmental health.

This integrated approach requires early coordination across disciplines, from HVAC and envelope design to material selection and long-term building operation. Through thoughtful specification of building systems, materials, and operational strategies, design professionals can ensure that buildings perform to the highest standards over their life cycle. Healthier indoor environments lead to improved comfort, cognitive function, and well-being, while incorporating resilient and sustainable features can also help reduce long-term operational risks and improve a building's value.

Looking ahead, the industry needs to adopt a mindset where occupant wellness and environmental performance are inseparable from durability and functionality. The buildings of the future are not only beautiful and efficient; they are adaptable, health-supporting, and environmentally responsive, shaping communities that are better equipped to thrive in a changing world. They are built to last, support occupant well-being, and adapt to changing environmental conditions, designed with both performance and purpose in mind.

additional information

AUTHOR

Alan Scott, FAIA, LEED Fellow, LEED AP BD+C, O+M, WELL AP, CEM, is Intertek's director of sustainability, building science solutions. He is a registered architect (RA) and sustainability expert with more than 35 years of experience and a lifelong commitment to the environment. In his early career as a practicing architect, he helped launch sustainable design practices at several major firms. Since 2000, as the 13th LEED AP, Scott has creatively applied his skills as a facilitator, consultant, project manager, and teacher in support of high-performance, sustainable built environment projects in North and South America. His project work focuses on improving building performance, decarbonization, occupant wellness, and resilience

KEY TAKEAWAYS

Healthy building design today is guided by frameworks such as LEED, WELL, and PRAs, which emphasize sustainability, occupant health, and long-term resilience.

Indoor air quality (IAQ) is a critical focus, requiring compliance with or surpassing ASHRAE 62.1, low-emitting materials, and high-efficiency filtration systems. Water quality is equally important, calling for thoughtful specification of fixtures and regular testing to ensure safety in all building types, particularly schools and healthcare facilities. Acoustic design contributes directly to wellness and productivity and should be addressed through appropriate material choices, spatial planning, and adherence to recognized sound performance standards. Designing for resilience involves proactive measures such as elevating critical infrastructure, using durable materials, and integrating passive systems and energy backups to ensure building functionality during disruptive events. Together, these frameworks help project teams deliver high-performance buildings that meet today's challenges and anticipate future demands.

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KEYWORDS

Division 01
IAQ
LEED
PRAs
WELL

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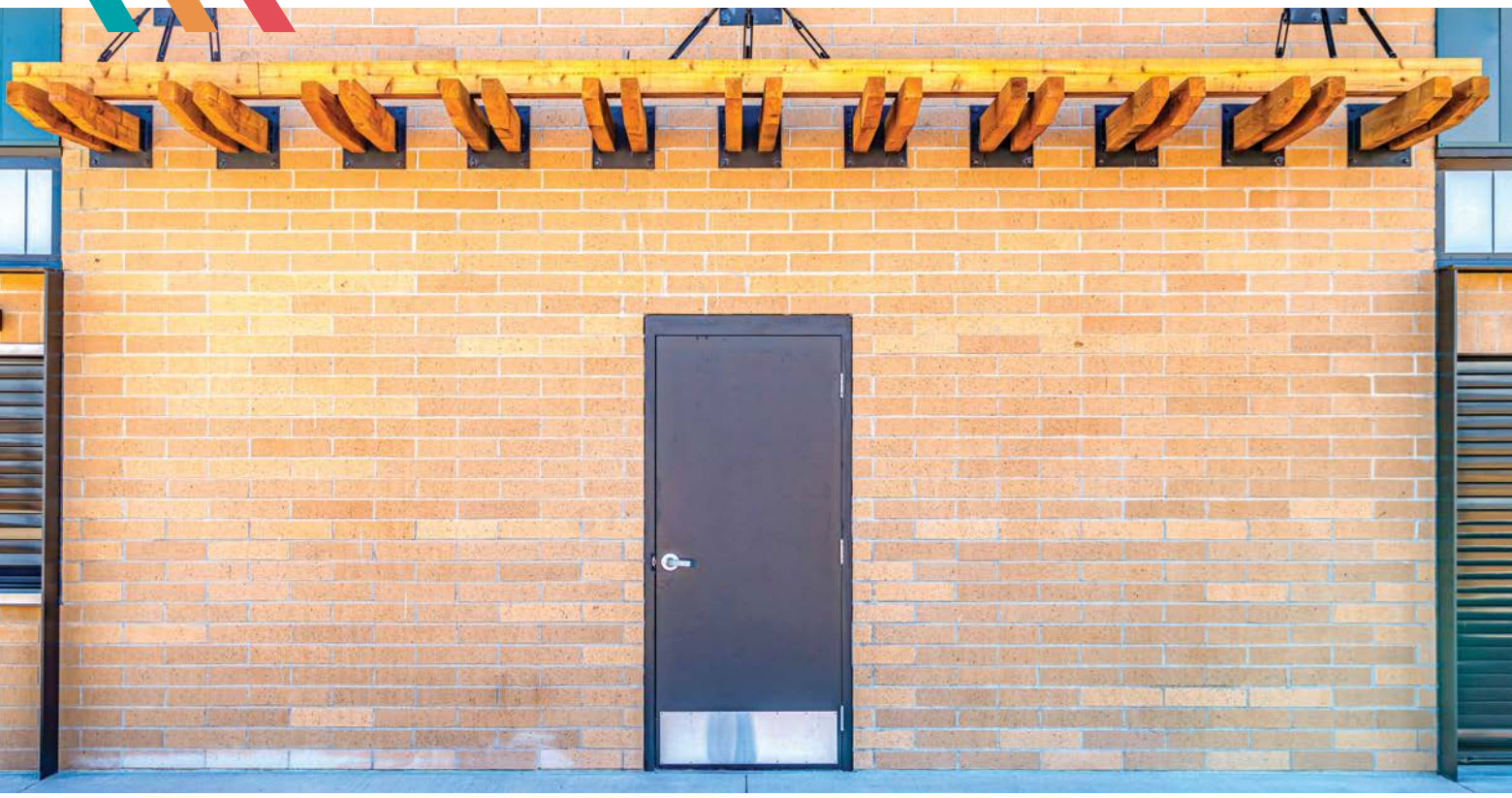


Choosing the Right Door Hardware with ANSI/BHMA Standards

By Tony Gambrall

PHOTOS COURTESY BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)/VIA STOCK.ADOBE.COM

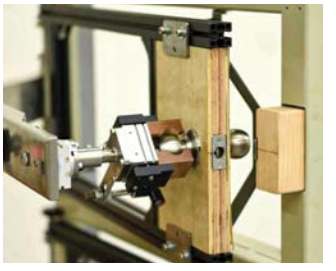
When specifying door hardware for a new or existing project, a lot of time and effort goes into ensuring every piece of hardware chosen will perform to its highest performance level. Seems simple, but every door opening has its own performance level and codes dictate this. How can specifiers ensure the door hardware chosen meets these differing levels? This is where the Builders Hardware Manufacturers Association (BHMA) and its door hardware standards can provide essential guidance.

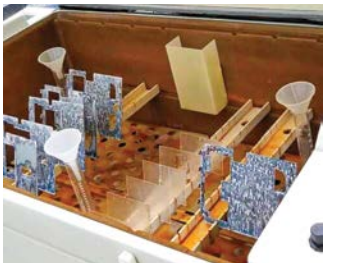
BHMA is the trade association for North American manufacturers of commercial builders' hardware and is involved in standards, codes and life safety regulations, and other activities that specifically impact builders' hardware performance standards for locks, closers, exit devices, and other builders' hardware.

BHMA is the only organization accredited by the America National Standards Institute (ANSI) to develop and maintain performance standards for locks, closers, exit devices, and other builders' hardware. BHMA currently has more than 40 ANSI/BHMA standards. The widely known ANSI/BHMA A156 series of standards describes and establishes features and criteria for an array of builders' hardware products including locks, closers, exit devices, butts, hinges, power-operated doors, and access control products.

The different levels of ANSI grades

A typical BHMA standard is categorized according to the hardware's intended use through the assignment of grades: 1, 2, and 3, with grade 1 representing the highest performance. Each grade is determined through a series of rigorous tests, which can include up to 15 to 20 different assessments. For instance, a grade 1 mortise lock must withstand 1,000,000 cycles in a cycle test, while grades 2 and 3 require 800,000 cycles. These strict laboratory tests are designed to guarantee that hardware exceeds these benchmarks in actual usage. Graded hardware aids in selecting the appropriate products, balancing performance and economic considerations.





Additionally, as the leader in commercial builders' hardware, BHMA recognizes the requirements for residential products differ enough from those of commercial products to have separate standards. As a result, BHMA has developed two residential standards: one for deadbolts and another for locksets. These standards require that consumers be made aware of the three key areas in which these products have been tested, including security, durability, and finish.[1]

A deeper dive into ANSI/BHMA Standards

Let's look at one of the standards: ANSI/BHMA, A156.1-2021 *Butts and Hinges*. This standard establishes requirements for butts and hinges. Cycle tests, lateral and vertical wear tests, friction tests, strength tests, finish tests, and material and dimensional requirements are included.

Material

The standard includes a table that lists the required steel gage and the number of fasteners for each standardized height. For example, a heavy-duty 127 mm (5 in.) hinge shall be made from steel gage 0.190 + .005 in and have four screw holes per mortised leaf.

Durability

Building products are expected to last a long time, and builders' hardware is no exception. Grade 1 hinges, for example, must pass a rigorous test through 2.5 million cycles of opening and closing on a door of a specified weight.

Safety and security

Hinges may be specified with additional safety and security features for the application. The standard defines hospital hinges as having sloped barrels, maximum security pins (MSP), and non-removable pins (NRP), among others.

Appearance

An additional duty of builders' hardware is to be aesthetically attractive and stay that way. Corrosion resistance is evaluated through a salt spray test to ASTM B117 providing confidence in the ongoing appearance of the architectural metals and coatings.

Building codes

Builders' hardware provides several attributes essential to building safety and performance, including egress and fire protection. BHMA hinges are designed to comply with all applicable requirements. For example, hinges which are acceptable for fire doors are described in NFPA 80.

Detention hinges

A section of the standard is dedicated to describing the requirements for detention hinges, including the test methods of ASTM F1758, *Standard Test Methods for Detention Hinges Used on Detention-Grade Swinging Doors.*

Sustainability

Locksets contribute to building sustainability through their verified durability, as well as material characteristics such as recycled content and recyclability. The reliable closing and sealing of openings can also contribute to energy conservation. BHMA has developed Product Category Rules, which will further define sustainability requirements and guide lifecycle assessments (LCAs) and environmental performance declarations (EPDs).

LEFT: Full mortise hinges, typical of a type A156.1 covers.

RIGHT ABOVE: Door hardware is a part of green building initiatives.

PHOTOS COURTESY BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)/VIA STOCK.ADOBE.COM

MIDDLE BELOW: Durability testing of commercial lock.

PHOTO COURTESY UNDERWRITERS LABORATORIES INC. (UL)

RIGHT BELOW: Salt-spray testing evaluates the corrosion resistance of a finish.

PHOTO COURTESY ALLEGION PLC

Type numbers

Another significant contribution of standards for product specification is a numbering system for hinge types. Please consult A156.1 for the full list; an example is provided here: A2412

- A—Section A
- 2—Material (wrought brass or bronze)
- 4—Type (half surface hinge)
- 1—Description (anti-friction bearing)
- 2—Grade (Grade 2)

Putting it together

Now, it is time to make the standard work for specifying a product. Using hinges again as the example, it is common knowledge that the opening requires the following hinges:

Stainless steel material, full mortise with frictionless bearings, and meets Grade 1 performance

From the A156.1 hinge standard, it is possible to put together an ANSI number of A5111. With that number, go to the BHMA Certified Product Directory1 and choose A156.1 as the standard. When the product page loads, enter A5111 in the "Click to show advanced search options" and products that meet the criteria will be displayed. As of today's writing, 186 certified products have an ANSI number of A5111.

Certification of ANSI/BHMA standards

ANSI/BHMA A156 Series Standards are developed following accredited procedures. Stakeholders and other interested parties are welcome to provide their comments for consideration. BHMA standards are updated at least every five years; the project initiation and public review period are announced in ANSI Standards Action as required by the ANSI Essential Requirements.

Certification program

Participants in the BHMA Certification Program voluntarily submit a hardware product to independent laboratory testing to confirm the product fully meets the criteria of its ANSI/BHMA standard. In-factory audits are coordinated periodically to ensure the products comply with the standard. Products unable to pass the auditing process face loss of certification. This industry-wide certification program does not call for a manufacturer to be a BHMA member to certify its products.

ANSI/BHMA standards: Labeling compliance

Knowing the importance of using certified builders' hardware is only part of what industry professionals and consumers need to know. It is equally crucial to understand how BHMA upholds the integrity of its certification program, ensuring that products tested to ANSI/BHMA standards can be trusted.

NOTES

1 See buildershardware.com/Certification-Program/Certified-Products-Directory

additional information

AUTHOR

Tony Gambrall serves as the BHMA director of standards. He coordinates the development and revision of the BHMA performance standards for building hardware products. He came to BHMA following a career in door hardware manufacturing, focusing in the areas of product testing and development. During this time, Gambrall was also a BHMA member participating and chairing in the development of standards. He can be reached at agambrall@kellencompnay.com.

KEY TAKEAWAYS

The Builders Hardware Manufacturers Association (BHMA) sets ANSI-accredited performance standards for commercial hardware like locks and exit devices. It uses graded classifications (1, 2, 3) based on rigorous testing to ensure durability, safety, and compliance with building codes. BHMA also provides residential standards and certification programs to verify hardware meets these requirements, helping specifiers choose suitable products for different building needs.

MASTERFORMAT NO.

08 71 00—Door Hardware

UNIFORMAT NO.

B1010—Doors and Entrances

KEYWORDS

Division 08
ANSI
BHMA
Doors
Hinges

From Old to New

Chicago's Retail Roof Overhaul

This roofing task was for one of the country's biggest online providers of furniture, rugs, lighting, and other home decor products, which now offers another option for in-person shoppers in the Chicago area. The online retailer's first true attempt to break into physical retail opened in the Spring of 2024 with more than 141,000 m² (152,000 sf) of retail space on Lake Avenue in Wilmette, Ill., about 22 km (14 miles) outside of Chicago. The new retail store offers interactive experiences from 19 departments, ranging from furniture and decor to outdoor living, home improvement, and more.

Roof replacement and renovation process

Before the state-of-the-art retail store could open, the vacant two-story building, originally built in the 1950s as home to Carson's department store, had to undergo a major facelift. This included a full interior gut renovation for the new program, as well as envelope improvements of the exterior facade and existing roof review.

As part of the massive renovation project, the facility's old 7,600 m² (82,000 sf) ballasted ethylene propylene diene monomer (EPDM) roof had to be assessed. As a result, the decision was made to remove the concrete deck completely and replace it with a newer technical system. This newer system is required to perform well in the harsh local weather and protect the store's valuable contents. The advantages of the technical update remove the weight of the ballast on the existing building and structure system as a benefit. The proposed allows a simpler technology to be seen if repairs are required in the future.

Challenges and complexities

Preservation Roofing Services of Romeoville, Ill., was hired to remove and replace the aging roof. Preservation Services is a third-generation roofing company that specializes in installing and maintaining a variety of commercial roofing systems, including polyvinyl chloride (PVC), thermoplastic olefin (TPO), EPDM, and modified bitumen. The company is a member of the National Roofing Contractors Association (NRCA) and the Chicago Roofing Contractors Association (CRCA).

"The roof was not your typical wide-open 7,600 m² [82,000 sf] job," says Brennan Quinn, project manager for Preservation Services. "The roof was divided into three sections, the largest of which includes a highly complex tapered system. In

By Justin Ramsey

PHOTOS COURTESY CARLISLE SYNTEC

Before the retail store could open, the vacant two-story building underwent a major facelift. This included a full interior gut renovation, as well as envelope improvements of the exterior facade and existing roof review.

addition, the roof has two knee wall dividers and a parapet wall that ranges from 1.2- to 4.2-m (4- to 14-ft) tall, several large concrete curbs for the old mechanical systems, a new clerestory atrium in the center of the building, a large new skylight, and large penthouse structure. So, there are plenty of things to deal with on this project."

Installation process and completion

Due to the nature of this overhaul, all the roofing work had to be coordinated between the general contractor and the various subcontractors working on the project.

The first step was removing the old roofing ballasted system and discovering nearly 50 original drains set in the concrete deck. The 10-person tear-off crew first vacuumed the roof and removed the old loose-laid EPDM roofing membrane installed over tapered expanded polystyrene (EPS) insulation.

Once 85 percent of the old roof was removed, they started re-roofing by installing a vapor barrier and temporary roof cover. The new air/vapor barrier material consists of a 40-mil composite sheet with 35 mils of self-adhering rubberized asphalt laminated to a 5-mil woven polypropylene film (to provide adherence to the substrate). The material is supplied in 1-mm (39-in.) by 30-m (100-ft) sheets.

The air/vapor barrier was secured to the deck using a two-component, low-rise, VOC-free, polyurethane adhesive. This material is supplied in 1-mm (39-in.) by 30-m (100-ft). The air/vapor barrier was then secured to the cleaned concrete deck using a two-component, low-rise, VOC-free, polyurethane adhesive. The crew applies Parts A and B of the adhesive to the concrete deck with a spray rig setup. A catalytic reaction (of parts A and B) allows the adhesive to mix, expand, and foam, creating the binder. Each resprayed adhesive layer expands to 1.6–3.2 mm (0.0625–0.125 in.) for an additional R-value of .020 to .050 for each pass. Now, with the barrier, the roof is temporarily protected.

"As part of the tear-off process, we had to remove and replace the old drains installed across the roof. We upgraded them with new construction drains, which will meet the service and performance expectations of the new roofing system," says Quinn.

The parapet walls range from 1.2- to 4.2-m (4- to 14-ft) tall.

As another coordination per the project's phasing, once the new drains were installed, the roofers covered them with the temporary roof membrane until the plumbing crew could connect them to the existing plumbing system beneath the roof deck.

In addition to the air/vapor barrier, the new roof assembly would eventually include two layers of 66-mm (2.6-in.) polyisocyanurate (polyiso) insulation, 3.2 mm (0.125 in.) of tapered polyiso insulation to provide slope to the drains, a 6.25 mm (0.2461 in.) gypsum-based cover board, and a fully adhered, white 80-mil PVC roofing membrane as the final product.

"Since this was an active construction project, we could only load the roof with about a third of the materials we needed at a time," adds Quinn. "Each load craned to the roof consisted of about 12 truckloads of materials including 1.2 x 1.2 m (4 x 4 ft) sheets of polyisocyanurate insulation, tapered insulation, cover board, as well as the membrane and adhesives."

Once the air/vapor barrier, which also acted as a temporary roof, was installed, the roofing contractor started with the smallest section of the roof and installed the two layers of polyiso insulation, staggering the joints to eliminate air leakage, as well as the tapered insulation, all with the two-part adhesive. The staggering of the joints helps increase the ability of the insulation panels to do their job. The direct adherence to the materials allows the roof to be installed better since there are no fasteners that might transmit heat through a system.

"The two-part adhesive is a great product and really easy to use. It's perfect for installing polyiso on concrete. Our plan called for a relatively tight bead pattern of 101.6-mm (4-in.) on center (o.c.) spacing in the corners, and 152.4-mm (6-in.) o.c. bead spacing around the perimeter and in the field of the roof.

A low parapet or knee wall divides the roof into three sections. The largest section, approximately 5,760 m^2 (62,000 sf), includes a new clerestory atrium with a standing seam metal roof, a penthouse for the elevator shafts and new mechanical units, a new skylight, and most of the roof drains.

"This was the most challenging part of the roof," says Quinn. "We had to install tapered insulation

In addition to an air/vapor barrier, the new roof assembly would eventually include two layers of 66-mm (2.6-in.) polyisocyanurate (polyiso) insulation, 3.2 mm (0.125 in.) of tapered polyiso insulation to provide slope to the drains, a 6.25 mm (0.2461 in.) gypsum-based cover board, and a fully adhered white 80-mil polyvinyl chloride (PVC) roofing membrane.

everywhere, plus there are about 20 crickets on that section of the roof, including on the mechanical penthouse, to properly slope the roof to the new drains."

For this part of the project, the roofing crew used the same two-part adhesive to install two layers of polyiso as fill insulation, with the tapered insulation over the top. In addition, due to the various drain locations and penetrations on the deck, the tapered design called for more than 30 separate sloped planes on that section of the roof with the mechanical penthouse, not including the crickets.

"Not only was the overall tapered design highly complex, but the field team also had to match four-way tapered layouts with two-way layouts in several locations, particularly around the new clerestory atrium, and the mechanical penthouse, which was really tricky," says Quinn.

The four-way and two-way terms refer to the tapered design for different ways to direct water to a drain. The four-way option is better, but it is more expensive than the two-way option. The application is determined by the specific roof and drain design.

The roofing contractor worked closely with the tapered insulation manufacturer to design a tapered layout that allowed water to flow freely around the numerous penetrations and the original concrete mechanical supports on the roof and to the internal drains.

"We had to taper almost the entire roof for drainage," describes Quinn. "But on one of the smaller sections, where the deck was already sloped, we were able to install just the flat stock and then add a few crickets to the drains, rather than sloping the entire section."

Once the insulation was installed, the entire roof was covered with the 6.25 mm (0.246 in.) reinforced gypsum cover board, which served as a solid substrate for the new PVC membrane. As noted previously, this cover board is also a good practice for insulation protection from maintenance traffic or harsh weather.

The last part of the project included installing the roofing membrane on the six canopy roofs around the building. The canopies are all about 1.5 m (5 ft) wide and about 6 m (20 ft) long. The membrane was fully adhered to, and the canopies were terminated with a shop-bent fascia system.

"We used the same two-part adhesive to install the polyiso, the tapered ISO, and cover board and we find that the large canisters [189 L (50 gal) drums] are really good for helping productivity in the field. Our guys averaged about 279 m^2 (3,000 sf) a day installing the tapered system," says Quinn.

Another challenge was dealing with the existing concrete curbs installed on the roof deck in various locations that originally supported the building's mechanical and air-handling equipment. Each of the 10 concrete curbs is about 9 m (30 ft) long, 508 mm (20 in.) high and spaced about 8 m (25 ft) apart in two different areas on the roof.

While not part of the roofing work, the concrete curbs had new steel decking installed across each section to create large flat 'roof' surfaces, spanning about 16 x 24 m (55 x 80 ft) in total. The new PVC membrane would cover these surfaces rather than leaving each support to be individually flashed and covered with the membrane. Installing the steel from curb to curb provided a new substrate, which could be covered with membrane, rather than running the membrane over and around each concrete curb, which would have been more time-consuming.

The roofing crew filled the voids between each concrete support with insulation and installed the reinforced cover board on the new metal decking between the concrete curbs. They then terminated the PVC membrane at the deck with fasteners and plates on all four sides, welded a new membrane bonded to the concrete curbs, and ran up and over the top.

All the 80-mil PVC membrane on the project was installed using a one-part sprayed contact adhesive with fast flash-off time for better productivity than traditional bonding adhesive application methods. The low-VOC adhesive is supplied in pressurized canisters and applied to both the roof deck or substrate and the back of the membrane using a 0.9-m (3-ft) long spray wand to ensure 100 percent coverage (fully

The roof was divided into three sections, the largest of which includes a highly complex tapered system. In addition, the roof has two knee wall dividers and a parapet wall that ranges from 1.2- to 4.2-m (4- to 14-ft) tall, several large concrete curbs for the old mechanical systems, a new clerestory atrium in the center of the building, a large new skylight, and large penthouse structure.

adhered). The adhesive contains solvents that have to evaporate or flash off before the roofing material is applied; once the adhesive flashes off, the membrane is rolled onto the deck, brushed in place, and then rolled with a weighted roller for maximum contact.

The entire roof has a perimeter parapet wall that ranges from about 1.2 to 4.2 m (4- to 14 ft.) tall. The tall sections are new portions of the facade that will eventually be the background for the company signage on the facility. The roofers installed a membrane from the deck up the side about 152.4 mm (6 in.) for the parapet walls and secured it with roofing fasteners and plates. They then welded new membranes below the fasteners and placed them up and over the parapet using the one-part adhesive, which was sprayed onto the wall and the membrane and then rolled in.

The internal knee walls between the various roof sections also had membrane installed up and over the top and were covered with a shop-fabricated coping cap.

The last part of the project included installing the roofing membrane on the six canopy roofs around the building. The canopies are all about 1.5 m (5 ft) wide and about 6 m (20 ft) long. The membrane was fully adhered to, and the canopies were terminated with a shop-bent fascia system. There was no gutter system or roof drains provided, making for an easier install.

additional information

AUTHOR

Justin Ramsey is the PVC product manager at Carlisle Construction Materials, where he oversees PVC roofing membranes, accessories, and adhesives for all company brands. With extensive cross-functional management experience and a proven track record in the manufacturing sector, he brings valuable insights to his current role. Ramsey holds a master of manufacturing management from Penn State and is a certified PMP; outside of work, he enjoys spending time with his kids, sailing, and serving as an assistant scoutmaster in his local Scout troop.

KEY TAKEAWAYS

A retail renovation in Wilmette, Ill., required a full roof replacement with different trades and team coordination. The 7,600-m^2 (82,000-sf) ballasted ethylene propylene diene terpolymer (EPDM) roof was removed, and a new technology high-performance system was installed. The system protecting the roof included a 40-mil air/vapor barrier (for flexibility in the installation and temporary roof protection), polyisocyanurate (polyiso) insulation (and tapered components), a gypsum cover (protection) board, and the final 80-mil PVC roof membrane. The tapered insulation system ensured proper drainage of the roof system, and the upgraded drain interfaces improved water management. All elements add up to a great roof for the building and many more years to go.

MASTERFORMAT NO.

07 50 00—Membrane Roofing
07 72 00—Roof Accessories

UNIFORMAT NO.

B2010—Roof Coverings
B2030—Roof Specialties and Accessories

KEYWORDS

Division 07
EPDM
EPS insulation
Polyiso
PVC

Ask The Expert

Do you have a question regarding the specific use of a product, material, or technique for a project that you are currently working on?

If so, these experts may have the answers you are looking for. These leading manufacturers and suppliers have provided solutions to some of the more common questions asked by AECO community. From the simplest questions relating to which product may be best suited for inclusion in specifications to how materials can assist in achieving green certification, you will find the answers here. In addition, you can also discover best practices related to installation to ensure product longevity.

Q: What makes TuffWrap SmartSeam Suspended Cover so "smart" and different from other temporary ceiling barriers?

A: TuffWrap's SmartSeam® Suspended Cover provides an innovative "smart seam" that captures dust and debris during construction. The temporary ceiling barrier is constructed from five-foot by six-foot panels of four-ply material, six-mil thick polyethylene, stitched with heat-sensitive thread that allows the ceiling panels to detach in the event of a fire. The "smart seam" opens like trap doors during a fire, allowing fire sprinklers to do their job. SmartSeam is the only company that is 100% International Building Code (IBC) Compliant and FM Approved. It can be placed beneath sprinklers, lights, and other elements located beneath the roof deck.

Q: What is TuffWrap's proprietary dust cap, and how does it enhance protection?

A: TuffWrap's proprietary dust cap is an added layer of defense placed over the seam, preventing fine dust particles and contaminants from passing through. This feature is critical in environments where airborne particles can damage equipment, compromise product integrity, or disrupt office spaces. No other temporary ceiling solution offers this level of extra protection.

Q: What risks do dust and debris pose during reroofing projects?

A: Dust accumulation can create serious safety concerns, including fire hazards and, in certain conditions, the risk of explosions. Traditional plastic ceiling covers, often stretched continuously over fire sprinklers and critical infrastructure, may not effectively contain dust or maintain fire safety compliance. In contrast, SmartSeam forms a secure yet flexible barrier that traps debris while allowing sprinklers to function if needed.

Q: How quickly can the SmartSeam Suspended Cover System be installed?

A: SmartSeam can be installed in just a few days, often during off-hours, minimizing disruptions to operations. Its quick installation helps reduce project timelines while ensuring a safer, more efficient work environment.

author information

David Gast, Director of Sales for TuffWrap Installations in the Eastern US and Canada, brings 25+ years of sales experience. He leads teams to success, boosts sales performance, and develops people.

TuffWrap is North America's leading provider of innovative dust, debris, and weather containment solutions during re-roofing, renovations, and reconstruction projects.

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Sustainable Solutions

Daylighting Design in Adaptive Reuse

By Neall Digert, Ph.D.

PHOTOS COURTESY SOLATUBE INTERNATIONAL

The significance of decarbonizing the built environment in limiting global warming to 1.5 C (34.7 F) cannot be overstated. With a projected 80 percent of the buildings in 2050 already standing today, retrofitting existing structures remains the best opportunity to be a pivotal lever for net-zero emissions.[1] Recent findings underscore the progress and the pressing need for expedited action in this domain.[2]

That same study evaluated the ambitions, policies, and strides made by significant economies in decarbonizing their built landscapes, specifically in the commercial sector. While some nations, such as Netherlands and France, show encouraging reductions in operational building emissions, the overall trajectory falls short. Key EU countries show a plateau in reduction efforts, and the United States has seen a concerning three percent increase in greenhouse gas (GHG) emissions from buildings since 2010 and is expected to continue increasing with significant intervention.

The built environment, despite its challenges, holds the key to a sustainable future. The urgency to retrofit existing buildings for sustainability becomes apparent when achieving net-zero emissions by 2050. The path to retrofitting presents numerous challenges, including an aging building stock and regulatory complexities. However, the built environment remains the pivotal opportunity in shaping a better future through innovation and a commitment to sustainability.

Case study: Ganahl Lumber

Established in 1884, Ganahl Lumber is one of Southern California's oldest and most respected businesses, known for providing quality hardware, lumber, and building materials. In 2010, the company had the opportunity to return to its roots in Pasadena, Calif., when a 1.6-ha (4-acre) General Motors dealership on the famed Colorado Boulevard became available for sale.

Although exciting and promising, the prospect of the adaptive reuse project presented many complexities upon acquiring the parcel. This included the challenge of converting the former automotive establishment into a retail store and lumberyard while accommodating its specific requirements. Moreover, the building also stands along the iconic Route 66, which meant the architecture team also had to adhere to the design standards set by the city and historical preservation society.

In addition to navigating a labyrinth of codes and regulations, the architecture team grappled

with the formidable challenge of reshaping the expansive interior into a space that exuded both comfort and aesthetic allure. The design team embraced a human-centric design. The objective was to depart from the conventional utilitarian atmosphere often associated with such retail settings, opting instead to craft an environment that offered a "high-end" experience that would delight customers and encourage them to linger.

Daylighting in sustainable design

To achieve this vision, the design team prioritized integrating an effective daylighting design. Studies have shown that natural daylight in buildings improves occupant comfort, which can directly affect consumer behavior.[3] A comfortable shopping environment can encourage customers to spend more time browsing, ultimately leading to higher sales.[4]

One study found that retail spaces lit with daylight experienced a sales increase of more than 40 percent compared to similar spaces selling comparable products without natural light.[5] Daylight provides psychological and physiological benefits to the building's occupants and accurately renders all wavelengths of light within the visible color spectrum. It allows merchandise to reflect its true colors with even intensity, making it more attractive to the human eye.

With this knowledge, the architects used 60 tubular daylighting devices (TDDs) to bring natural daylight into the deep center of the expansive retail space. TDDs work well for high-bay applications such as Ganahl Lumber, as they can capture sunlight on both sunny and cloudy days. Unlike traditional skylights, TDDs work by capturing the sun's rays with an optical dome mounted on the roof. The light is then transferred downward through reflective tubing. Once the daylight reaches the interior, it is evenly distributed throughout the space using diffusers without adding glare or heat.

The simple cylindrical shape of the TDD is integrated with other elements, including HVAC, electric lighting, fire sprinklers, and signage, resulting in a cohesive and harmonious design for the open ceiling. The TDDs were strategically placed with the diffuser lens close to the roof deck to ensure shelves, displays, and other objects would not obstruct the emitted daylight. Other systems were layered below, with signage positioned at the bottom, floating elegantly over merchandise displays and racks. This purposeful positioning maximized the natural light from the TDDs, reducing the use of electric lighting during daylight hours, contributing to a more sustainable retail environment, highlighting specific merchandising, drawing customer attention, and enhancing the overall shopping experience.

Results and recognition

The daylighting design met the design objectives and yielded remarkable results for Ganahl Lumber. The store's revenues exceeded expectations, and the project won an AIA Pasadena & Foothill Chapter Honor Design Award in the restoration/adaptive reuse category.

The head architect on the project also noted how the TDDs helped ensure Ganahl Lumber is a building materials 'destination' in the community. It is known for being visually appealing and a great place to get help with building projects. This store has also inspired the design of other Ganahl Lumber locations. The design values and elements

LEFT: 60 tubular daylighting devices (TDDs) were used to bring natural daylight into the deep center of the expansive retail space.

MIDDLE: Daylight allows merchandise to reflect its true colors with even intensity, making it more attractive to the human eye.

RIGHT: The tubular daylighting devices (TTDs) directed daylight into the building, highlighting merchandise.

The design team used daylight to create a "high-end" experience that delights customers and encourages them to linger.

featured at the Pasadena store established guidelines for renovating other pre-existing Ganahl locations in Southern California and continue to foster the company's future development and commitment to sustainable design.

Retrofitting for the future

The Ganahl Lumber adaptive reuse project demonstrates the potential for transforming existing buildings into sustainable spaces that integrate functional goals, business objectives, and aesthetic standards. As the world aims for net-zero emissions by 2050, such innovative retrofits provide a blueprint for overcoming challenges and leveraging sustainable design practices for a better future. Retrofit projects offer significant opportunities to reduce carbon emissions, enhance building longevity, improve comfort, offer health advantages, and increase asset value.

Knowledge, solutions, and technologies are already available to significantly improve building energy performance. However, concerted efforts are needed to overcome barriers and accelerate the adoption of retrofitting practices on a larger scale. Through innovation and a commitment to sustainability, the built environment can be uniquely positioned to play a vital role in shaping a better future.

NOTES

1 Refer to ukgbc.org/our-work/climate-change-mitigation/
2 See the study at www.3keel.com/wp-content/uploads/2023/11/GRI_2023-1.pdf
3 Refer to this Walmart study of sales under skylights at static-assets-solatube.s3.amazonaws.com/s3fs-public/field/files/tech_resources/Daylighting%20Facts%20%26%20Figures-Retail%20Sales.pdf
4 Read about the benefits of natural daylight at www.nrel.gov/docs/fy02osti/30769.pdf
5 Review the study on retail spaces at eneref.org/reports/eneref_daylight_retail_bigbox.pdf

additional information

AUTHOR

Neall Digert, Ph.D., MIES, vice president, innovation and market development at Kingspan Light + Air North America, has more than 30 years of consulting and education experience working in the energy/lighting/daylighting design and research fields, and specializing in the design and application of advanced lighting and daylighting systems for commercial building applications.

KEY TAKEAWAYS

The push for sustainable retrofitting is crucial for achieving net-zero emissions by 2050, but challenges such as aging buildings and complex regulations complicate the process. Ganahl Lumber's transformation and rehabilitation of a former automotive dealership into a sustainably designed lumberyard highlight these difficulties. The architecture team navigated adaptive reuse, balanced city and preservation standards, and successfully modernized the space. Integrating natural daylight through tubular daylighting devices (TDDs) proved itself a key solution to enhance comfort and boost retail sales by creating a welcoming and engaging atmosphere.

MASTERFORMAT NO.

08 62 00—Unit Skylights
08 62 23—Tubular Skylights

UNIFORMAT NO.

B3010—Roof Coverings
F1010—Special Structures

KEYWORDS

Division 08
Adaptive reuse
Lighting
Tubular daylighting devices

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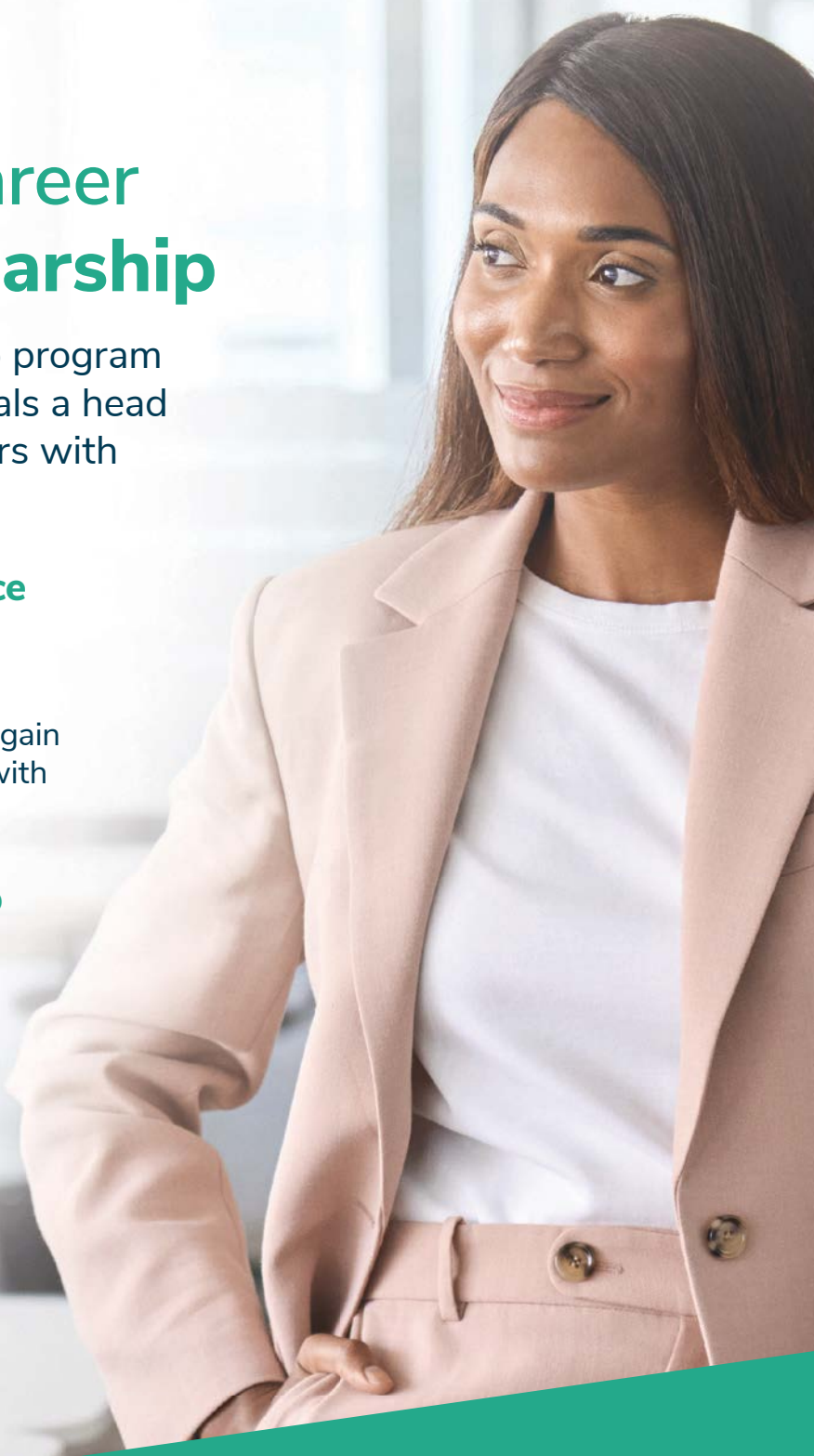

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Proactive HVAC Maintenance

Balancing Costs with Sustainability

By Andrew Soulier and Bryant Kuvako

PHOTOS COURTESY ECM TECHNOLOGIES

RIGHT: Installing advanced lubricant in aging HVAC system.

As the HVAC industry approaches the first half of 2025, it finds itself at a pivotal crossroads between rising equipment costs and a greater demand for sustainability. These challenges create substantial opportunities for innovation and leadership across the industry. This article examines how a proactive approach to HVAC maintenance can help owners and operators reduce costs in the short term and be better prepared for future upgrades.

With equipment prices anticipated to rise further, extending the lifespan of existing systems will be crucial for managing costs. Additionally, the evolving landscape of building performance and decarbonization policies requires industry professionals to remain adaptable and responsive to new regulations. By balancing both financial and environmental responsibility, facility managers can help steer their organizations to be more sustainable and cost-effective from the inside out.

Rising equipment costs and the need for preventative maintenance

Since 2020, HVAC equipment prices have surged, driven by rising raw material costs, supply chain disruptions, regulatory changes and labor shortages.[1] Some equipment costs have nearly doubled, with an average increase of around 40 percent. Contributing factors include the phase-out of R-410A refrigerants and the introduction of low-GWP alternatives such as R-454B, which have driven up manufacturing costs. Major manufacturers, such as Lennox and Carrier, project significant price increases even into the future as they adapt to modern regulatory changes and introduce new product lines.

With rising costs in the HVAC industry—exacerbated by impending refrigerant changes and the likelihood of further price increases—the trend toward repairing existing systems rather than replacing them is gaining momentum.

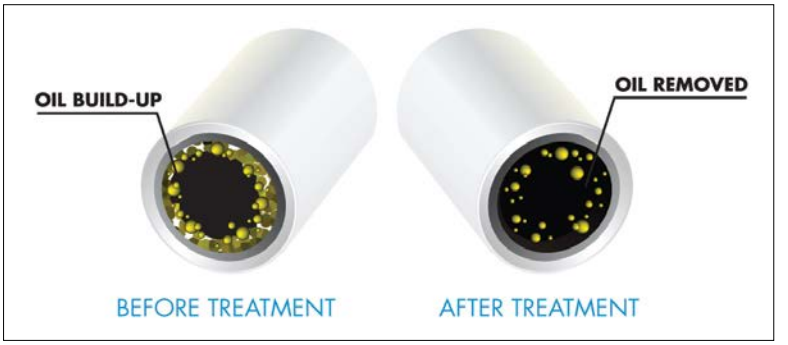
Repairing and maintaining existing systems helps control expenses by extending equipment lifespan, reducing the frequency of costly emergency repairs, and improving energy efficiency. Without routine upkeep, aging HVAC systems consume more energy and are prone to sudden failures, leading to unplanned financial burdens.

To mitigate these expenses, HVAC professionals must shift from reactive to proactive maintenance strategies. Regular maintenance is no longer just a best practice—it is a financial necessity. Proactive system management, including routine inspections, cleaning and timely repairs, ensures that equipment operates efficiently, reducing downtime and decreasing energy consumption by 10 to 20 percent.[2]

The financial impact of deferring HVAC maintenance can be substantial. Reactive approaches to system issues often lead to emergency repairs that carry premium costs, with the risk of more severe, long-term damage that may necessitate complete system replacements. In contrast, a comprehensive preventive maintenance plan identifies and addresses potential issues before they escalate, fostering predictable budgets and reducing the likelihood of unplanned financial burdens. Property owners who prioritize regular check-ups and servicing reduce operational disruptions and enhance tenant comfort, protect property values and stabilize operating expenses. Moreover, preventive HVAC maintenance is integral to energy efficiency—a critical factor in cost management and sustainability—aligning with both economic and sustainability goals.

Enhancing system efficiency with advanced lubricant

Traditional maintenance for commercial HVAC systems typically emphasizes mechanical components, focusing on reducing breakdowns and improving energy efficiency. However, a critical yet often overlooked aspect of system performance is the degradation of refrigerant oil. Over time, the oil breaks down and accumulates on the interior surfaces of heat exchanger coils, creating a thermal insulating barrier. Instead of returning to the oil sump in the compressor where it belongs, the oil adheres to the tubes, impairing heat transfer. As a result, buildup reduces system efficiency and leads to increased energy consumption, negatively impacting overall performance.



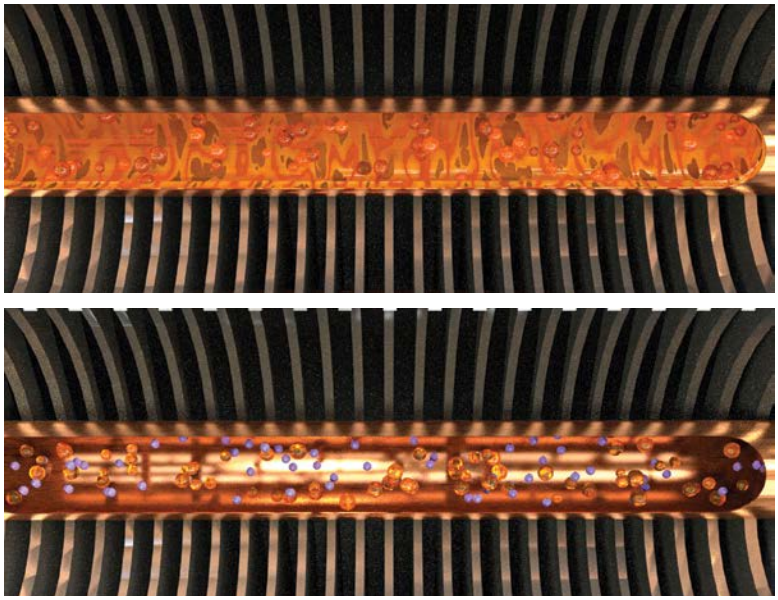
Before and after oil fouling.

Many industry professionals are now turning to advanced lubricants to address this issue. These chemical compounds enhance heat transfer and reduce wear and tear on HVAC components. Independent studies have validated that modern oil lubricants deliver significant benefits, such as quick payback periods, up to 20 percent recurring savings on operational costs and long-term system performance improvements. By adopting these advanced solutions, facility managers can not only boost efficiency but also extend the lifespan of both new and aging HVAC systems, ensuring better financial returns.

Adapting to benchmarking, energy, and sustainability policies

The HVAC industry is also being shaped by city, state, and national policies to improve building energy performance and/or achieve significant carbon reduction targets. As these policies push businesses toward cleaner and more efficient technologies, HVAC systems—which account for 67 percent of the total emissions in buildings[3]—are under increased scrutiny. As aging equipment fails, replacing systems with identical models offers little progress toward sustainability goals. Instead, facility managers must identify opportunities to upgrade to more energy-efficient solutions while staying within budget constraints.

Getting ahead of the curve does not have to be financially overwhelming. Facility managers can strategically manage this shift by reducing short-term costs, implementing upgrades gradually, optimizing current systems and leveraging available incentives to alleviate financial pressure. By pairing short-term wins with pieces of a long-range plan, FMs can help soften costs and build momentum for future upgrades.



Before and after oil additives.

The strategic importance of sustainability

Sustainability in HVAC operations has become a priority for many organizations, driven by the significant energy consumption of HVAC systems and the environmental impact of refrigerants used in most equipment, which are closely monitored under greenhouse gasses (GHG) reporting protocols.

A recent report by the International Energy Agency (IEA) states HVAC systems contribute to a staggering 15 percent of global CO2 emissions.[4] As a result, emerging policies aimed at reducing carbon emissions will either directly or indirectly lead to stricter HVAC energy efficiency standards and incentivize the adoption of greener technologies.

For facility managers, adopting sustainability as a best practice is not just a compliance measure but a strategic move toward long-term success. This starts with eliminating energy waste and improving maintenance practices to reduce operating expenses in the short term but evolves into programming better efficiency into operations and procurement over the long term. Businesses can significantly reduce their environmental impact and operating expenses by implementing a series of no-cost and low-cost measures and use those savings to help justify further investment in sustainable performance and/or regulatory compliance.

Sustainable strategies should produce clear benefits in the following areas:

- Enhancing compliance and competitive edge—Ensuring adherence to evolving regulations while providing a competitive advantage.
- Improving cost efficiency and long-term savings—Reducing energy bills and maintenance costs through energy-efficient systems.
- Optimizing performance and reliability—Reducing operational costs and maintenance needs with modern, sustainable HVAC systems.
- Reducing environmental impact—Lowering GHG emissions with energy-efficient technologies.
- Enhancing indoor environment and productivity—Boosting productivity and wellbeing through improved indoor air quality and comfort.
- Future-proofing—Preparing for future regulations and market demands with early adoption of advanced technologies.
- Implementing proactive maintenance strategies—Extending the life of existing equipment, improving system efficiency and preventing costly emergency repairs through regular inspections, cleaning and timely repairs.

Leveraging AI for HVAC optimization

AI and machine learning are revolutionizing HVAC systems by optimizing predictive maintenance, control strategies, diagnostics, and load balancing. These advancements reduce energy consumption, operational costs, and emissions. AI can optimize HVAC systems through:

- Predictive maintenance—Preventing costly repairs by forecasting failures and optimizing performance. For example, AI-driven sensors can analyze vibration patterns in compressors to predict failures, reducing unplanned downtime and extending equipment lifespan.[4]
- Optimized control strategies—Adjusting settings in real-time based on occupancy and weather conditions.
- Fault detection and diagnostics—Reducing time and resources necessary to identify a fault.
- Energy use optimization—Minimizing energy consumption while maintaining comfort.
- Dynamic load balancing—Efficiently distributing heating and cooling loads across multiple units more efficiently. A real-world example is AI-driven HVAC systems in large hospitals that adjust air handling units to balance demand in different wings, preventing overuse of certain equipment while optimizing both comfort and energy efficiency.

Testing HVAC equipment with thermal gun.

Equipped with these insights, while emerging AI and property technology offer promising opportunities, the foundational principles of efficiency and maintenance remain crucial. The most effective facility managers understand the importance of balancing both—leveraging cutting-edge technologies while maintaining a strong focus on traditional maintenance practices. It is not a matter of choosing one over the other, but rather integrating both strategies to ensure optimal performance and long-term sustainability.

Leading the way beyond 2025

As 2025 progresses, the HVAC industry faces both challenges and opportunities. Industry leaders can effectively navigate these pressures by prioritizing proactive maintenance and sustainability. Maintaining and optimizing existing equipment remains a critical strategy for controlling costs, improving efficiency, and extending system lifespan. At the same time, embracing new technologies—such as advanced lubricants and AI-driven monitoring—can enhance performance, reduce energy consumption, and support sustainability goals.

These innovations and a strong maintenance strategy provide significant operational savings and ensure new and aging systems operate at peak efficiency. Looking ahead, the HVAC industry has the potential to lead in sustainability, setting new standards for environmental responsibility and innovation. Facility managers who take a proactive approach—integrating preventive maintenance and emerging technologies—will be well-positioned to excel in the competitive and regulation-driven landscape 2025 and beyond.

NOTES

1 See www.achrnews.com/articles/154696-hvac-equipment-prices-expected-to-keep-rising

2 Refer to betterbuildingssolutioncenter.energy.gov/solutions-at-a-glance/preventative-maintenance-commercial-hvac-equipment

3 For more information, visit www.iea.org/energy-system/buildings

4 Read more at www.mdpi.com/1424-8220/25/4/1006

additional information

AUTHORS

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KEY TAKEAWAYS

As HVAC costs rise and sustainability demands grow, proactive maintenance is key to reducing expenses and extending system lifespan. Innovations such as AI and advanced lubricants enhance efficiency, while regulatory shifts require adaptability. Integrating smart maintenance and sustainability strategies ensures long-term success in a competitive, evolving industry.

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KEYWORDS

Division 23
AI
HVAC
Sustainability

Weather-resistant Barriers

Advanced Technologies for Modern Construction

By Andrew Irvine

PHOTOS AND ILLUSTRATION COURTESY TYPAR CONSTRUCTION PRODUCTS

In recent years, moisture management has become increasingly important for multifamily and commercial construction teams due to higher expectations for building performance and more stringent building codes and regulations. Many materials and installation practices contribute to air- and moisture-resistant building envelopes, with weather-resistant barriers (WRBs) playing a pivotal role.

The 2018 *International Building Code (IBC)* Section 1403.2 defines "water resistive barrier" as "not fewer than one layer of No.15 asphalt felt, complying with ASTM D226 for Type 1 felt or other approved materials, shall be attached to studs or sheathing, with flashing as described in Section 1404.4, in such a manner as to provide continuous water-resistive barrier behind the exterior wall veneer"

The American Architectural Manufacturers Association (AAMA) defines weather-resistant (not "resistive") barriers as a surface or a wall responsible for preventing air and water infiltration to the building interior. Manufacturers of polymer-based barriers (*i.e.* building wraps) also distinguish between water-resistive and weather-resistive barriers, with the latter providing the added benefit of also serving as an air barrier for the vertical building enclosure.

The *IBC* code requirements stipulate minimum requirements for a water- or weather-resistant barrier. Hence, the minimum standard is compared to No #15 felt paper, the original "house wrap" or "building wrap" before all the woven, non-woven, and drainable introductions. When discussing a weather-resistant barrier, look for a "balance of properties," including bulk air and water holdout, breathability, and durability. All four properties should be present in WRB for optimal functionality and home/structure protection.

The performance of a WRB depends on the material's ability to maintain its integrity—no matter what comes into contact with it. This article will define the WRB performance characteristics specifiers need to know about and outline key tests and certifications that can help ensure the right material for a project.

Moisture management and drainability

As its most basic function, a WRB must hold out water. A high-performance building wrap will be able to pass both a "water ponding" test, which measures a building wrap's resistance to a 25.4-mm (1-in.) pond of water over two hours, and a more stringent hydrostatic pressure test where the material is subjected to a pressurized column of water for five hours.

However, as the trend for tighter building assemblies continues to grow, building wraps must be able to balance permeability with drainability to both prevent water from becoming trapped in the wall and allow any moisture that does become trapped to evaporate effectively.

The drainage efficiency of a building wrap is generally tested in accordance with ASTM E2273, *Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies*. During the ASTM E2273 test, a spray box with two small openings for water application is sealed to a wall assembly. Next, water is sprayed onto the wall for 75 minutes, with the water collected measured at 15-minute intervals. Water flow and dispersion are held constant throughout the test.

Once the 75 minutes are up, the wall sits idle for an additional hour before measuring the collected water drained from the wall assembly. If greater than 90 per cent of the total applied water has drained and been collected, the wall assembly is said to be in accordance with ASTM E2273. Section R703.9.2 of the 2018 *International Residential Code (IRC)* and Section 1407.4.1 of the 2018 *International Building Code (IBC)* require the wall to have an average minimum drainage efficiency of 90 percent when tested in accordance with ASTM E2273.

Given the proliferation of drainable building wraps on the market, builders and specifiers should pay close attention to how quickly bulk water drains, as it can vary significantly. According to ASTM E2273, some high-performance building wraps have been shown to achieve drainage efficiency of greater than 90 percent, and some leverage innovative technologies to take this even higher.

Today's most advanced building wrap products feature integrated drainage gaps through creping, embossing, weaving, or filament spacers. These new products eliminate the need for furring strips, helping reduce material costs and streamline installation. The cutting-edge drainable building wrap technology is products that create a drainage gap through an additional layer of polypropylene fibers. One of the leading commercial drainable building wraps uses this technology to create a drainage gap and has achieved 96.7 percent drainage efficiency per ASTM E2273 while still handling and installing like a standard building wrap.

ABOVE: Today's most advanced building wrap products feature integrated drainage gaps through creping, embossing, weaving, or filament spacers. These new products eliminate the need for furring strips, helping reduce material costs and streamline installation.

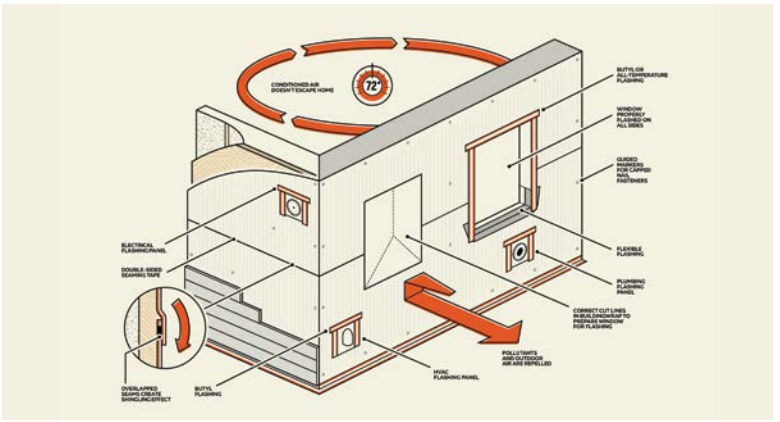
LEFT: This drainable wrap achieves a drainage efficiency of 96.7 percent through an integrated layer of polypropylene fibers.

This added layer of protection is particularly important in coastal climates and areas subject to heavy wind-driven rainfall. These products can be installed in any direction without affecting performance.

Permeability

A WRB must be able to breathe to prevent moisture vapor from getting trapped in the wall assembly. Permeability measures the amount of vapor transmission that a building wrap will allow over a period of time. ASTM E96 is the Water Vapor Transmission Rate (WVTR), also called Moisture Vapor Transmission Rate (MVTR), which the industry calls "PERMS" or "permeability." ASTM E96 and ASTM E2273 are industry standards for measuring drainability and permeability. Permeability is the measure of moisture through the WRB or wall system (*i.e.* it can be tested on a standalone product or as part of a system).

The key to permeability is that when designing a wall, it should have a system of products so there is potential for any water to escape to the outside or exterior of the wall system. If a wall system is designed with no permeability and water gets into the interior, then there would be no mechanism by which the moisture/water could escape to the outside, which could lead to rotting, mildew, etc. Once moisture reaches the exterior, ASTM E2273 or drainage comes into play. Therefore, ASTM E96 and ASTM E2273 are co-mingled in the sense that when designing a wall system, ensure there is a path for moisture to



ABOVE: Installing a high-performance building wrap as part of a complete system with compatible tapes, flashings, and sealant ensures all components work as intended to maximize air and water holdout.

BELOW: After being exposed to surfactants and subjected to a weathering machine for two days, the left building wrap did not show any damage before or after a scratch test, while the middle and right one both became brittle.

escape to the outside and then once it hits the exterior wall component (here housewrap or buildingwrap or WRB) has a path to escape down the wall system. The key here is keeping water out.

ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*, addresses two testing procedures for measuring permeability—desiccant and water methods.

In the desiccant method, the material to be tested is sealed to a test dish containing a desiccant or drying agent, and the assembly is placed in a controlled atmosphere. Periodic weighing determines the rate at which water vapor has moved through the specimen into the desiccant. In the water method, the dish contains distilled water, and periodic weighing determines the rate of vapor movement through the specimen from the water.

In most wall assemblies, outwardly driven moisture will not cause many problems (unless one is dealing with a material such as stucco painted with a low-perm paint, in which case bubbling and cracking would be visible). However, the inwardly driven moisture presents a problem, especially when conditioned indoor air is much cooler than the warm, moist exterior.

Typically, this inwardly driven moisture vapor is managed by separating the cladding from the rest of the assembly with a capillary break, a gap or a sheathing material able to shed or not absorb or pass water. Impermeable sheathing, such as extruded polystyrene (XPS), is one option for halting inward vapor drive. In these assemblies, the inwardly driven moisture condenses on the surface of the XPS sheathing and drains downward.

However, in situations where a reservoir cladding is paired with a highly permeable sheathing like gypsum board (which can be as high as 50 perms) or a moisture-retentive material such as oriented strand board (OSB), an air gap may not be enough to slow down inward moisture intrusion. In these applications, a WRB is needed to reduce unwanted moisture intrusion.

The International Code Council (ICC) requires a product's permeance rating to be at least five perms to be classified as a water-resistive barrier instead of a vapor retarder. This distinction stems from the fact that a vapor retarder reduces the rate at which water vapor moves through a material, and the older term "vapor barrier" is still in use, even though "vapor retarder" is more accurate. According to the Department of Energy (DOE), materials are categorized by their ability to resist water vapor diffusion, measured in units called "perms" or permeability. For example, materials with a permeance rating of five perms or higher fall within the range of Class III vapor retarders, which can include items such as house wrap. It is important to note that a higher perm rating does not always indicate a better water-resistive barrier, as the performance of the barrier depends on the specific conditions and requirements of the building.

"Inward Drive – Outward Drying," a paper written by building scientist Joseph Lstiburek,[1] recommends that specifiers aim for the "sweet spot" of 10–20 perms to achieve the desired moisture protection and breathability balance. Achieving the optimal perm rating ensures that while water is prevented from entering the wall cavity, ideal levels of moisture vapor are still allowed to escape. He writes that if it is too high, the moisture driven out of the back side of a reservoir cladding, such as brick or stucco, into the air space will blow through the layer and the permeable sheathing into the wall cavity. Too low, and the outward drying potential of the cavity is compromised. Fortunately, building wrap technology, mainly using a "systems" approach, can help builders hit the sweet spot for permeance.

Air holdout

The Air Barrier Association of America (ABAA) defines an air barrier as a system of assemblies

within the building enclosure designed, installed, and integrated to stop the uncontrolled air flow into and out of the enclosure. Establishing a continuous air barrier is crucial for several reasons, as it isolates the indoor environment and significantly impacts the overall energy efficiency, comfort, and indoor air quality (IAQ) of a building. According to DOE, up to 40 percent of the energy used to heat and cool a building is consumed due to uncontrolled air leakage. A continuous air barrier also helps lower greenhouse gas (GHG) emissions by reducing heating and cooling costs.

An air barrier controls the airflow between conditioned and unconditioned spaces, serving as the primary boundary between indoor and outdoor air. In multi-family construction, it also separates the conditioned air of individual units and their adjacent units. However, it is important to note that while many materials can meet the ASTM air leakage requirement, the real-world performance of an air barrier system depends on proper installation. The material's durability on the jobsite and the integrity of connections are critical; even one unsealed seam or tear can compromise the entire system's effectiveness. It is also essential to distinguish between air and water-resistive barriers, as they serve different functions in building design.[2]

For an individual building material to be classified as an air barrier, its air permeance must be equal to or less than 0.02 L/(s•m^2) at 75 Pa (0.00394 cfm/sf at 1.57 psf) when tested following ASTM E2178, *Standard Test Method for Air Permeance of Building Materials*. However, this air permeance test only measures the amount of air migrating through the material itself, not through holes or gaps in the larger assembly. Therefore, it is important to consider a material's effectiveness as an air barrier largely depends on proper installation and the use of compatible tapes, fasteners, and sealants.[2]

Understanding how an air barrier material performs when installed as part of a compatible system is much more valuable. To receive approval from ABAA, an air barrier must pass the organization's air leakage standards when tested in accordance with ASTM E2357, *Standard Test Method for Determining Air Leakage of Air Barrier Assemblies*. This type of test is intended to more accurately replicate how a wall system will perform in a real-world setting. It includes various elements, such as wind loading, making it a more reliable measure of the system's performance. When tested in accordance with this standard, the air barrier must be 0.20 L/(s•m^2) @ 75 Pa (0.04 cfm/sf @ 1.57 psf) in both directions (*i.e.* infiltration and exfiltration).

Air barriers can also be defined through whole-building testing in accordance with ASTM E779, *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization*. This test method is intended to measure the airtightness of building envelopes of single-zone buildings. For this test method, many multi-zone buildings can be treated as single-zone structures by opening interior doors or inducing equal pressures in adjacent zones.

Taking a system approach

The key word in this discussion is assembly or system, as both are appropriate in this context. While the term "assembly" may evoke thoughts of fire-rated wall constructions, it is also important to note that those are simply collections of components tested together as a unit. In the case of air and moisture management, the WRB must be considered alongside related elements such as flashing tapes, sealants, and other accessories. These components form an integrated wall assembly or system designed for bulk air and water holdout.

For example, sealants with high solvent or plasticizer content can damage bitumen flashing products, causing functional and aesthetic issues. When seams and tears are not adequately taped, windblown rain can infiltrate the assembly. Failure to use galvanized roofing nails or plastic cap nails to attach the WRB to the sheathing and framing can also compromise performance.

To counter this problem, some manufacturers have developed a system approach that includes compatible tapes for seaming and adhesive flashings for openings. When installed together, these systems are often assured through extended warranties from the manufacturer. When in doubt, always check the manufacturer's website for additional guidance.

Durability

Construction sites can be challenging, and if the building wrap is not tested to withstand tears,

Regarding building wrap, the International Code Council (ICC) tests durability on two primary indicators: tensile strength and tear resistance.

scratches, prolonged exposure to UV light, and common construction chemicals, it will not perform how it needs to once installed.

Regarding building wrap, the ICC tests durability on two primary indicators: tensile strength and tear resistance. These factors are critical because the wrap needs to withstand the handling and installation process without compromising its air- and water-resistive properties.

Tear resistance, as measured by trapezoidal tear tests (ASTM D1117/ASTM D5733), is a good measure for predicting a building wrap's ability to withstand the rigours of the job site and to stay on the wall after installation. "In-plane" is the best measurement of tear resistance. The trapezoid tear test, the best measurement of in-plane tear resistance, takes place when the building wrap is fastened to the wall and is subjected to tearing in the plane of the wall.

Some building wraps claim tensile strength based on ASTM D882, a test for thin plastic sheeting, not nonwoven fabrics. Since the product is never used this way, these measurements are not meaningful. However, the grab tensile measurement is meaningful. ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, tests a 1.2 x 1.8 m (4 x 6 ft) material sample and clearly states it is designed for nonwoven fabrics, making it a much better metric for evaluating building wraps.

Another factor to consider is the ability of a building wrap to withstand incidental scratches from utility knives, nails, and other tools. While no ASTM standards govern scratch resistance testing for building wraps, some manufacturers commission third-party testing to demonstrate the performance of their products. A scratch-resistant wrap is less likely to suffer from surface damage that could weaken the material, ensuring it lasts longer and continues to perform effectively. Ensure that the wrap being used has been tested for scratch resistance.

UV resistance

Another primary performance attribute in a high-performance WRB is its ability to stand up to UV exposure. This is a critical point of differentiation between weather barriers, as prolonged exposure to UV radiation can cause material degradation, leading to loss of tensile strength, delamination of surface layers, and reduced water repellency. This is especially true in commercial construction, where there are already prolonged construction schedules that are often slowed by several factors. For these reasons, UV exposure must be at the forefront of mind when selecting a system of weather protection products.

While the goal should be to clad the exterior of the building as quickly as possible, projects are often delayed, leaving WRBs vulnerable to longer-than-expected exposure to the sun. Many building wraps currently on the market only offer up to 120 days of UV resistance, with the best offering up to 12 months without degradation to their performance capabilities. This can be an incredibly important differentiator for commercial projects where extended project timelines often leave the WRB exposed for a considerable amount of time.

Surfactant resistance

When evaluating WRBs, specifiers should seek an optimal balance of performance characteristics, including air and water resistance, durability, and sufficient permeability. However, one property, surfactant resistance, is commonly overlooked by building professionals. Builders and contractors who do not have a basic understanding of surfactants and how they impact the performance of a building wrap could potentially jeopardize the long-term durability of the exterior wall assembly.

Surfactants (surface active agents) are contaminants that lower the surface tension of a liquid, allowing it to penetrate deeper into the WRB material. Water soluble extractives in wood, such as tannins and wood sugars in redwood and cedar, are examples of surfactants that contaminate the surface of building wraps. In addition, surfactants can be found in detergents, soaps, and other cleaning solutions used to

power wash siding, making surfactants almost impossible to avoid.

Why is this a problem? Surfactants promote the loss of water repellency, causing "wetting" of the building wrap surface. Once this occurs, water can more easily pass through the microscopic openings in the building wrap. Once moisture finds its way into the building envelope, it can threaten its structural integrity, causing exterior surfaces to deteriorate. Bulk moisture intrusion can also support mold and rot, which cause structural damage and pose serious health hazards to building occupants.

When choosing a building wrap, pay attention to its surfactant resistance capabilities. Not all wraps will provide the same surfactant protection, if any at all. Recent testing conducted by an accredited third-party testing facility with ISO 17025, Miami-Dade, American Architectural Manufacturers Association (AAMA), and AABA certifications compared three well-known weather-resistant barriers when subjected to a common surfactant (dish soap and water) and revealed that one outperformed the other two across the board.[3]

Although it is never advisable to expose WRBs to surfactants, most will be exposed despite best intentions. So, builders and contractors must select a wrap resistant to these chemicals. Due to the vast amount of building wraps and moisture management products on the market, it is more imperative than ever to make the right product selections to design and build wall systems that perform to today's high performance, durability, and moisture control standards.

Conclusion

Specifying the right WRB is critical for achieving a high-performance building envelope that meets today's stringent building codes. Understanding the key performance measures—such as moisture management, permeability, air holdout, durability, UV resistance, and surfactant resistance—ensures a building wrap that protects against the elements and enhances the overall longevity and energy efficiency of the structure. Taking a systems approach and specifying WRB materials that strike an optimal balance between these various performance characteristics ensures informed decisions that contribute to the success and sustainability of projects.

NOTES

1 Refer to buildingscience.com/documents/building-science-insights-newsletters/bsi-061-inward-drive-outward-drying

2 Learn about the different types of barriers and their functions at airbarrier.org/wp-content/uploads/2021/09/WB-WRB-AB-VB-Are-They-Not-All-The-Same.pdf

additional information

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Andrew Irvine is a senior product manager at TYPAR Construction Products. He has extensive experience in the building and construction industry, including global product management, national account management, and finance. Irvine is responsible for the building and construction portfolio, including the TYPAR product line.

KEY TAKEAWAYS

Moisture management is crucial in construction, especially for multifamily and commercial buildings. Weather-resistant barriers (WRBs) are key for preventing water intrusion and promoting air and moisture control. WRBs must balance permeability, drainability, and durability. Performance tests such as ASTM E2273 ensure efficient drainage and moisture management. WRBs should also resist UV degradation, air leakage, and surfactants to maintain performance. Specifying WRBs that work within a system and meet building codes ensures long-lasting, energy-efficient buildings. Proper installation and material compatibility are essential for optimal performance in controlling moisture and airflow.

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07 25 00—Weather Barriers

UNIFORMAT NO.

B2110—Exterior Walls

KEYWORDS

Division 07
Drainability
Moisture management
Thermal insulation
Vapor barrier
Weather-resistant barriers (WRBs)

A Step Above

Retrofit of Existing Stair Nosings

By Tim Brennan

PHOTOS COURTESY WOOSTER PRODUCTS

Thoroughly mix the epoxy, aggregate, and hardener.

Applying thoroughly mixed DIY mixture to the prepared steps with a trowel or similar tool according to directions.

In today's fast-paced world, people are always on the move, often hurrying or pacing around. This hurried lifestyle can lead to actions such as dashing up or down a set of stairs. The conditions of the stairs can greatly affect safety in these instances; if the steps are worn, uneven, or poorly lit, the risk of slipping or tripping increases. A moment of distraction or haste can result in serious accidents. This is why when Michigan Innovation Headquarters (MI-HQ) renovated a former Eastern Michigan University College of Business building to house University of Michigan Medicine (Michigan Medicine) facilities, they paid as much attention to the stairs in the parking garage as they did to the patient-facing areas inside the building.

When fully operational, the Ypsilanti facility will serve 150 or more patients daily. In addition to the three floors for Michigan Medicine, there will be several floors for Mi-HQ, with multiple labs catering to biotech, robotics, cell chemistry, and other emerging industries. While much of the renovation is centered on the customer- or patient-facing portion of the building, many of those patients will likely access the parking garage, so MI-HQ is also bringing the parking garage up to code, including extensive repairs to the west stairs.

Repair solutions

The garage was initially constructed in 1990, and the west stairwell was the only one with significantly degraded stair nosings. A thorough inspection before starting the repair process did not reveal any clues as to what caused the damage to the stairs.

Non-slip stair nosings and treads come in several forms and typically rely on an abrasive material, usually silicon carbide, mixed with epoxy to provide a slip-resistant leading edge for each step. The abrasive material is factory-applied to a depression along the leading edge of a manufactured tread profile. Aluminum nosing profiles may be designed to be embedded into the concrete step while it is being formed. Surface-applied rubber or aluminum profiles are also available for adhesive installation at the step after the concrete has cured and dried sufficiently. The abrasive materials significantly increase the coefficient of friction, and thus the gripping force, to decrease the likelihood that someone might slip on the surface, even when wet.

The building owner initially considered purchasing new aluminum nosings to replace those with missing grit, but at $70 each or more, that quickly exceeded their planned expenditure. The flooring contractor involved in the repair of nosings identified a field-applied abrasive product consisting of a three-part mixture. This product is intended for

refilling and repairing aluminum treads in both indoor and outdoor applications and exhibits resistance to solvents, chemicals, and water. It reportedly meets or exceeds the resistance standards set by various regulatory agencies, including OSHA, *ADA*, ASTM, ANSI, and UL-140. Additionally, this product is designed to retrofit nosings from different manufacturers to ensure compliance with resistance standards.

After discussions with the manufacturer, a single pail of the newly developed material was ordered for evaluation. This was intended to assess ease of installation, coverage rates, and overall product quality. Each kit includes a canister of the two-part epoxy mixtures in the exact proportions required, the abrasive grit mixture, a drill mixing tool, a plastic applicator to help guide the mixture into the aluminum channels, and detailed instructions.

The first step of the process was removing the loose abrasive material from the steps to be repaired. This was accomplished by scraping the damaged abrasive material from the aluminum housings or using a wire brush, removing as much of the original abrasive as possible. After taping off areas around those needing repairs, the flooring installer thoroughly mixed the materials and began at the topmost step. He scooped ample mixture onto the aluminum substrate and worked it into the channels with his trowel. He then smoothed the horizontal surface and worked the mixture onto the leading edge to ensure it was well-coated. He found that a corner trowel tool worked well for placing material along the leading edge and smoothing it. The directions stated the repaired stairs should be ready for foot traffic in about 24 hours, but the flooring installer cordoned them off for 48 hours. He returned the next day to check on them but gingerly traversed the stairs without stepping on the repaired sections.

The 28 repaired steps.

Finished result

Each kit is intended to cover 14 m (45 ft) of nosing that is 0.07 mm (3 in.) wide and filled to a depth of 4.7 mm (0.1874 in.). Mi-HQ initially bought five buckets but returned one unopened after finishing the project. In total, the flooring contractor repaired 28 steps. The cost for the four buckets was about $600, which was more cost-effective compared to the initial estimate of $70 per step for replacing the entire nosing. Additionally, replacing all the nosing would have required more effort and time.

As the new tenants begin populating the newly refurbished building, they will notice the new paint, flooring, lighting, and equipment and furnishings. With their non-slip properties and newly refurbished steps, the parking garage stairs will continue to make every step safe.

additional information

AUTHOR

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KEY TAKEAWAYS

Michigan Innovation Headquarters (MI-HQ) prioritized stair safety during the renovation of a former Eastern Michigan University building to house Michigan Medicine facilities. As part of the project, MI-HQ focused on repairing the west parking garage stairs, which had degraded stair nosings. They used a field-applied abrasive product to refurbish 28 steps. The renovated stairs, now non-slip, will ensure safety for the daily influx of patients and tenants in the new facility.

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Respect the edge distance

In many assemblies, anchors need to be embedded in stone or similar masonry substrates. Honoring anchor edge distances is an important design consideration. Significant stone masonry repair was required in two recent projects where appropriate edge distances were not provided.

In the first example, a roofing termination bar was installed on a profiled coping in a historic limestone-clad building in the Midwest. The roofing termination was anchored to the limestone coping with nail-in anchors with an edge distance of only 38 mm (1.5 in.). This caused loose spalls to develop in the stone at many anchors three stories above the adjacent street, presenting a falling debris hazard (Figure 1). A contractor was engaged to remove the loose material, and the stone coping is currently scheduled for replacement. An increased edge distance would have helped avoid this problem, and combined with a different roofing termination detail, it may have been possible to avoid the situation altogether.

The next example, from an institutional building in the Midwest, involves sheet metal flashing installed to protect the stone cornice and secured by cleats at the outside edge. The cleats were secured with nail-in type steel anchors positioned approximately 50 mm (2 in.) from the edge of the stone. Unfortunately, even this edge distance was insufficient to prevent cracking and spalling at the thin outer edge, particularly at joints between segments of the continuous cleat where two fasteners were installed a few inches apart (Figure 2). Installation of the flashing system, intended to protect the stone, caused significant damage and a life-safety hazard from falling overhead material.

In general, anchors should be positioned a minimum of 75 mm (3 in.) from the edge of natural stone units. The critical distance depends on the size and type of anchor, the substrate's type and configuration, and the connection's geometry. While anchor manufacturers may indicate minimum edge distances in product data, these distances are typically based on the structural performance of the anchor and its use in a reinforced concrete structure. The indicated distances may not be sufficiently conservative for a natural stone substrate. Some anchors, such as nail-in anchors or expansion bolts, may impart more stress into the substrate as compared to screw or adhesive anchors. Less intrusive fasteners are appropriate for substrates on historic structures.

figure 1

figure 2

FIGURE 1: A roofing termination bar was anchored close to the edge of the limestone coping, leading to spalls.

FIGURE 2: The cleat used at the edge of the cornice flashing was secured with nail-in fasteners. Cracking and spalling occurred throughout the length of the cornice.

PHOTOS COURTESY WISS, JANNEY, ELSTNER ASSOCIATES (WJE)

Minimum edge distance requirements for anchors should be clearly specified. While locating anchors away from edges and corners may require larger straps, longer cleats, or similar modifications, the cost of these materials is far less than repairing damaged masonry. In some cases, an alternative detail can be provided to eliminate the need to anchor near the edge of the stone. For example, in the second project, the proposed remediation includes the use of rigid plywood underlayment that can be secured near the center of the stone, providing a suitable substrate for anchorage for the sheet metal close to the outer drip edge.

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