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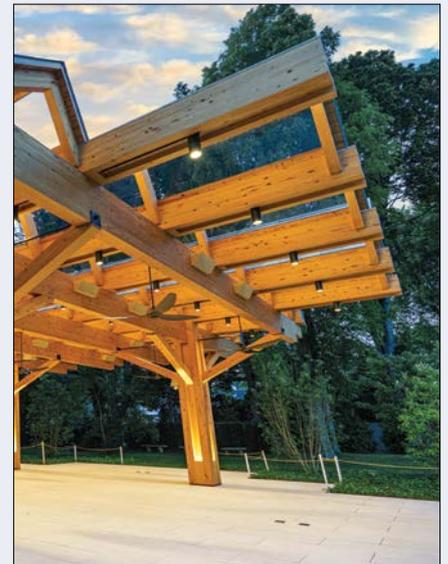
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**On the cover:**

*A mass-timber pavilion designed by Dattner Architects at a New York worship campus redefines wood's architectural potential. Crafted from durable Alaskan yellow cedar, the structure integrates water management directly into its glulam framework, channeling rain through sculpted beams and columns. Inspired by natural forms, the design unites landscape, acoustics, and spirituality through expressive, high-performance timber engineering.*

PHOTO BY R. GARRITY POWERS  
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# Sacred Structures

## How Timber Shapes the Architecture of Worship

By Mike Banta

PHOTO BY  
R. GARRITY POWERS

Few building materials possess the profound ability to inspire a sense of reverence and evoke feelings the way that wood can. Timber has been written into the narrative of human experience, cultural heritage, and architectural innovation. As such, it naturally creates a bridge to both past and future.

Since the dawn of humanity and the earliest days of religious worship, there has been a deep connection to trees. Many cultures believe that trees are spirits themselves. As early as the 4<sup>th</sup> century BC, druids in Europe were known to worship in oak groves, which they considered sacred.

In ancestry and among some people today, trees are a powerful manifestation of the earth itself, but also serve a very real and practical purpose as a source of wood, an ancient building material still widely used. In recent years, wood has risen to the forefront of building material innovation as architects and developers have begun to harness its potential as a carbon-

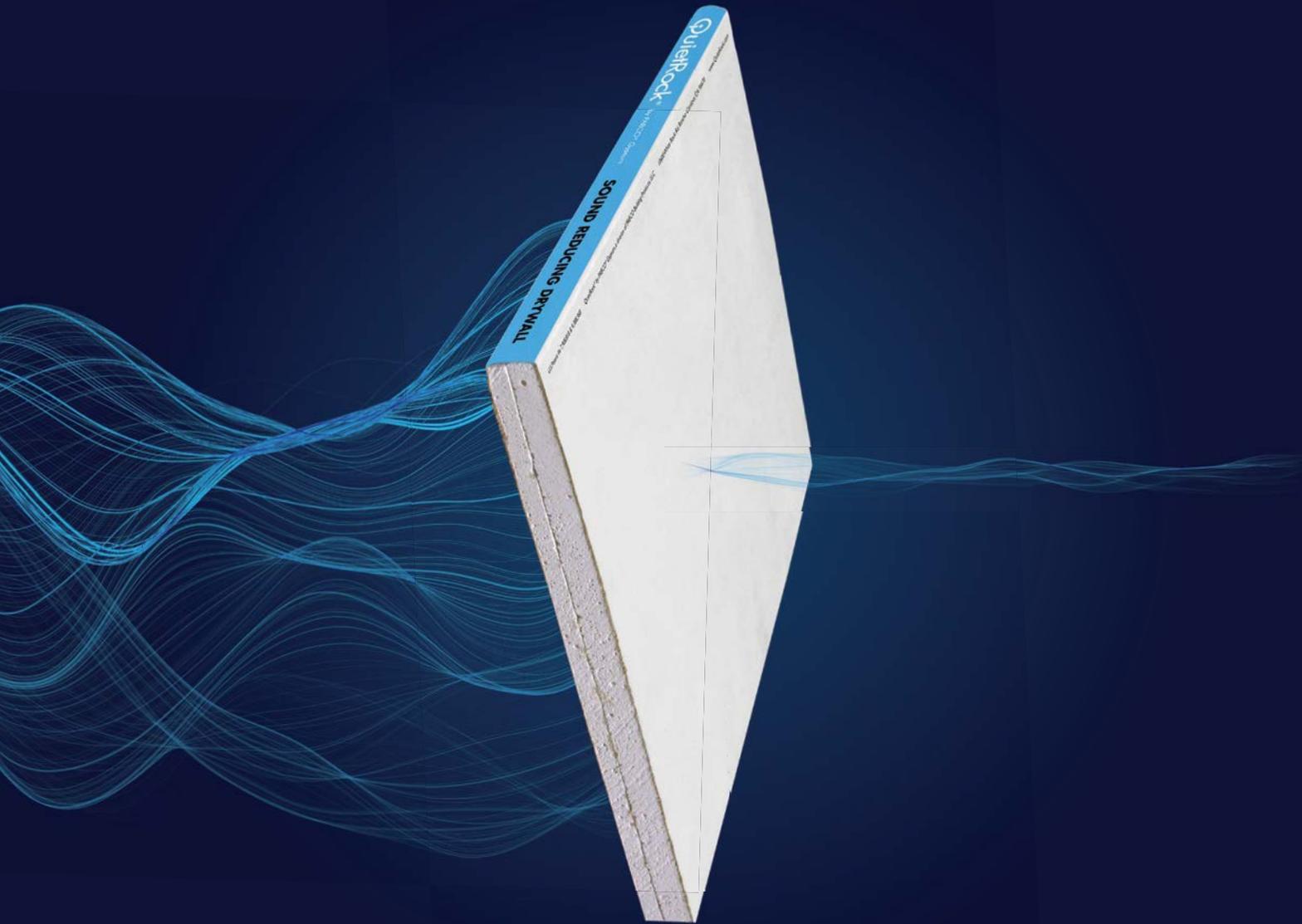
neutral, 21<sup>st</sup>-century structural material. But while timber is beginning to serve as the backbone of today's high-rises and other commercial facilities, it is still avidly used in one of its earliest applications—spiritual spaces.

### Wood for worship

Timber is a storyteller. It has life and carries centuries of architectural tradition. In spiritual spaces and buildings designed for worship, timber frames can do more than provide shelter. Wood creates an atmosphere of reverence and warmth, connecting contemporary congregations with the spiritual past.

“Wood in a religious setting is a reminder of nature, and the visible contributions of human harvesting and work,” says Richard Dattner FAIA, principal at Dattner Architects, and a designer of worship spaces that uses timber.

Perhaps the most iconic example of the physical and spiritual power of timber can be found in the hammer beam trusses of London's Westminster



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The Chabad of Bedford features a combination of Douglas fir glulam and solid timber.

PHOTOS BY JANA BANNAN

Abbey. Commissioned in 1393 by King Richard II and measuring 21 x 73 m (68 x 240 ft), it is the largest medieval timber roof in Northern Europe.

This masterpiece of design continues to captivate worshippers and visitors alike. To an observer, the centuries-old, seemingly impossible cantilevered design creates a sense of strength, durability, and wonder. The awe produced by this blend of spirit, nature, strength, and permanence is what designers of worship spaces today seek to emulate. Many recent projects demonstrate how architects are reimagining timber's role in spiritual architecture.

### Timeless and modern

While wood is an ancient building material, that does not mean it is not innovative. Today's engineered wood products provide greater degrees of performance and flexibility to designers while still embodying the elements that make timber such a timeless material. For example, glue-laminated timber, or glulam, is a structural product constituted by layers of dimensional lumber bonded with durable, moisture-resistant structural adhesives. These materials are available to today's designers and builders of worship spaces.

Trinity Community Church in Hockessin, Del., showcases a modern approach to timber design using glulam trusses in southern yellow pine with a natural clear finish. It features expressed steel connections and tension-rod joinery in a matte black powder-coat finish.

With a span of 12 x 20 m (40 x 65 ft), the lobby incorporates 161 pieces of timber totaling 22.45 m<sup>3</sup> (9,515 board ft). Outside, 35 timber brackets supporting exterior overhangs express the timber beneath the eaves. The scale of the project highlights the intentional celebration of timber in design.

### Spiritual sustainability

Beyond aesthetic and structural considerations, sustainability has come to the fore when considering timber's role in spiritual spaces. In an era of growing environmental consciousness, wood embodies a connection to the planet and a commitment to responsible stewardship.

The Chabad of Bedford illustrates this concept. By strategically combining Douglas fir glulam and solid timber, the design team was able to minimize material use while maximizing structural efficiency. The project incorporated structural insulated panels with an impressive R-40



insulation value to provide superior energy efficiency and performance to the building.

Timber framing has a lower embodied carbon footprint than steel or concrete.<sup>1</sup> This advantage stems from timber's natural carbon sequestration process: trees absorb carbon dioxide as they grow, storing it within their fibers even after harvesting. Timber production also requires less energy-intensive processing than steel or concrete manufacturing. The renewability of timber, coupled with responsible forestry practices and efficient construction techniques, further contributes to its reduced environmental impact.

Mark Hughes, professor of Wood Material Technology at Aalto University in Finland, notes in the book, *Rethinking Wood: Future Dimensions of Timber Assembly*,<sup>2</sup> that building construction accounts for between 30 and 50 percent of material usage, while construction and demolition waste accounted for 32 percent of total waste in the EU 27 in 2012.

"Timber is arguably our most important green construction material," said Hughes, "it is abundant, renewable, possesses good technical characteristics, and can be converted into a host of different 'engineered' wood products with relatively minor inputs of energy and other materials."<sup>4</sup>

Further, timber framing is a champion of waste reduction and recycling, embodying the principles of a circular economy. First, there is very little waste generated in highly efficient production processes. Artisans working in controlled plant conditions can cut all pieces to

necessary lengths with great precision, making the most effective and complete use of the materials. Secondly, offcuts and byproducts are carefully repurposed or recycled, reducing the burden on landfills. This sustainable approach aligns with responsible forest management practices, in which harvested trees are use efficiently, leaving very little waste.

Additionally, less work on the jobsite means less air pollution, dust, and noise in areas near other buildings and communities. This is good for the general environment, as well as for neighbors who are not eager to be near dirty, noisy, and long-lasting construction projects.

### Form and function

Part of the enduring appeal of wood is its flexibility and utility. As technology and techniques improve, that element continues to grow. At the Jewish Center of the Hamptons in New York, a new pavilion represents an example of a modern approach to designing with mass timber. In this project, the material transcends its traditional structural role and steps into an integral part of the building's water management system. Alaskan yellow cedar glulam was selected for its durability in a coastal environment, with carefully designed channels that collect and redirect water through the structural elements.

The pavilion's design mimics natural forms, creating a profound connection between the built environment and the landscape. Skylights, sawtooth roof profiles, and meticulously planned water drainage systems transform timber from a

The project used structural insulated panels with an R-40 insulation value, ensuring exceptional energy efficiency and building performance.



Trinity Community Church in Hockessin, Del., showcases a modern approach to timber design using glulam trusses in southern yellow pine with a natural clear finish.

mere construction material into a holistic architectural element. Dattner Architects took care to optimize the materials they utilized on the project.

“This dramatic, timber-framed pavilion is set in a landscaped grove adjoining a historic, mid-century place of worship,” Dattner explains. “The Alaskan Yellow Cedar matches the interior of the sanctuary, as do the angled, north-facing skylights. The 3,500 sf [325 m<sup>2</sup>] pavilion roof is supported on four ‘cluster’ columns—each consisting of four joined vertical members. The roofing is zinc-coated copper, and the unique ‘H’ shaped beams also serve as gutters collecting rainwater to pipes down the four columns.”

For those who worship inside the sanctuary, the innovative design and material applications have provided spiritual and practical benefits, including sound management.

“The cantor has spoken about the amazing acoustics of the Sanctuary,” explains David Wasserstein, director of operations for the facility. “While I’m sure a lot of that comes from the geometry of the space, some of it comes from the resonance of the wood itself. It’s not entirely dissimilar from the use of woods in opera houses and concert halls.”

### Uninterrupted service

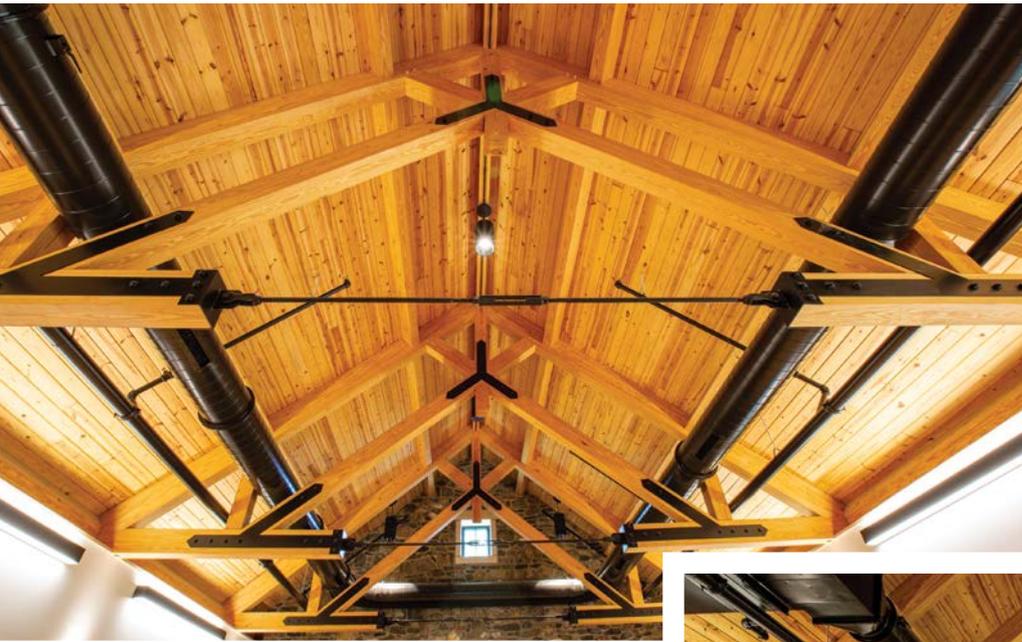
From the building occupant and use perspective, houses of worship are unique in that they operate

year-round, often holding services on the holidays when other building types are closed. Some religions hold daily prayer, and all the business of the gathered body happens throughout the week. To this end, anything the project team can do to accelerate the renovation process helps minimize interruptions to the building’s operations and order.

By its nature, off-site timber construction can significantly enhance a project’s overall efficiency. Offsite components can be manufactured while foundations are being poured and are ready to receive them. Monitored manufacturing settings equipped with precise fabrication tools, automated processes, and standardized workflows deliver quality control and consistency levels that surpass anything possible on a construction site. Additionally, off-site construction means a more consistent work crew and a more controlled workflow that is less prone to disruption.

When components are built in a climate-controlled factory, it virtually eliminates the risk of weather-related delays. When it comes to scheduling, off-site production facilities are also more reliable, making timelines and costs more predictable. And in factory construction, workers can become specialized experts in their craft, leading to higher-quality products.

In the new construction of a spiritual space, there is also the emotional payoff for the building



The church features expressed steel connections and tension-rod joinery in a matte black powder-coat finish. The lobby incorporates 161 pieces of timber, and outside, 35 timber brackets supporting exterior overhangs express the timber beneath the eaves.

occupants when a construction project comes to a resolution.

“Other than a family waiting for the key to their new house, no other type of construction project has people more excited for the grand opening than a church body,” says Rev. Chris Eden, pastor at Otterbein United Methodist Church, Lancaster, Pa. “They have invested time and resources into fundraising, held countless planning meetings, have talked about it at every service, and they can’t wait to invite friends and family to see the new space.”

Taking much of the work off the job site makes for a tidier environment, generating less waste and debris on the site. There are also advantages on the job site itself. With less construction happening onsite, even tight or remote sites become easier to work with.

“In urban areas, space is at a premium,” says Mike Banta, general manager with Mid-Atlantic Timberframes. “Storing construction materials and equipment on-site during the building process is not ideal, and maybe not even possible. Builders can save space by having heavy timber components built in a factory and scheduled for precise, on-time delivery to the site.”

### Inspiring awe

Architects consistently emphasize timber’s ability to inspire. In spiritual spaces, the elements are not hidden but celebrated. Exposed trusses, visible connections, and thoughtful detailing invite congregants to appreciate the structure’s inherent beauty as they gaze upward. Whether in



historic cathedrals or modern spiritual centers, these designs continue to captivate and delight the eye.

Wooden structures inspire awe and reverence. Nobody is putting timber in a church and then covering it up. The timber connects to the past and anchors the space. There is a durability and reassurance in using timber as a building material in a spiritual space.

Looking to the future of spiritual architecture, timber continues to offer a unique promise. It bridges historical tradition with contemporary design, provides sustainable solutions, and creates spaces that inspire spiritual reflection. Modern timber-frame design requires collaboration, and successful projects demand precise coordination among architects, builders, and timber suppliers. Every detail matters.



At the Jewish Center of the Hamptons in New York, skylights, sawtooth roof profiles, and meticulously planned water drainage systems transform timber from a mere construction material into a holistic architectural element.

PHOTOS BY  
R. GARRITY POWERS

Timber is often chosen for worship spaces, not just for its structural capabilities, but for its ability to tell a story. Each beam, each truss carries with it a narrative of responsible harvesting, skilled craftsmanship, and architectural innovation. Wood in spiritual spaces is a philosophical statement as much as it is a design choice. The material speaks to humanity's connection with nature, its respect for craftsmanship, and the desire to create spaces that transcend the everyday. Mass timber combines traditional craftsmanship with contemporary sustainable design, creating spaces that are both spiritually evocative and environmentally responsible. 🌲

#### NOTES

- <sup>1</sup> Refer to [research.fs.usda.gov/treesearch/67831#:~:text=In%20this%20study%2C%20the%20substitution,emissions%20and%20address%20GWP%20mitigation.](https://research.fs.usda.gov/treesearch/67831#:~:text=In%20this%20study%2C%20the%20substitution,emissions%20and%20address%20GWP%20mitigation.)
- <sup>2</sup> See [dokumen.pub/rethinking-wood-future-dimensions-of-timber-assembly-9783035617061-9783035616897.html](https://dokumen.pub/rethinking-wood-future-dimensions-of-timber-assembly-9783035617061-9783035616897.html)

## additional information

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**Mike Banta** is general manager at Mid-Atlantic Timberframes. From a young age, he was fascinated by the exposed structural elements of timber framing and admired the longevity and character of the timbers. For more than 20 years, he has been designing timber frame structures and has advanced expertise in glue-laminated timber (GLT), cross-laminated timber (CLT), timber and steel hybrid systems, and other structural components, including structural steel and reclaimed and recycled timber. He is also well-versed in sustainable design, 3D modeling and detailing, CNC programming, prototyping, and quality control.

#### KEY TAKEAWAYS

Timber continues to shape spiritual architecture by uniting tradition, modern engineering, and sustainability. From historic

cathedrals to contemporary mass-timber sanctuaries, wood offers structural performance, low embodied carbon, and powerful emotional resonance. Off-site fabrication improves construction efficiency, while exposed timber frames enhance acoustics, durability, and the sense of reverence central to worship spaces.

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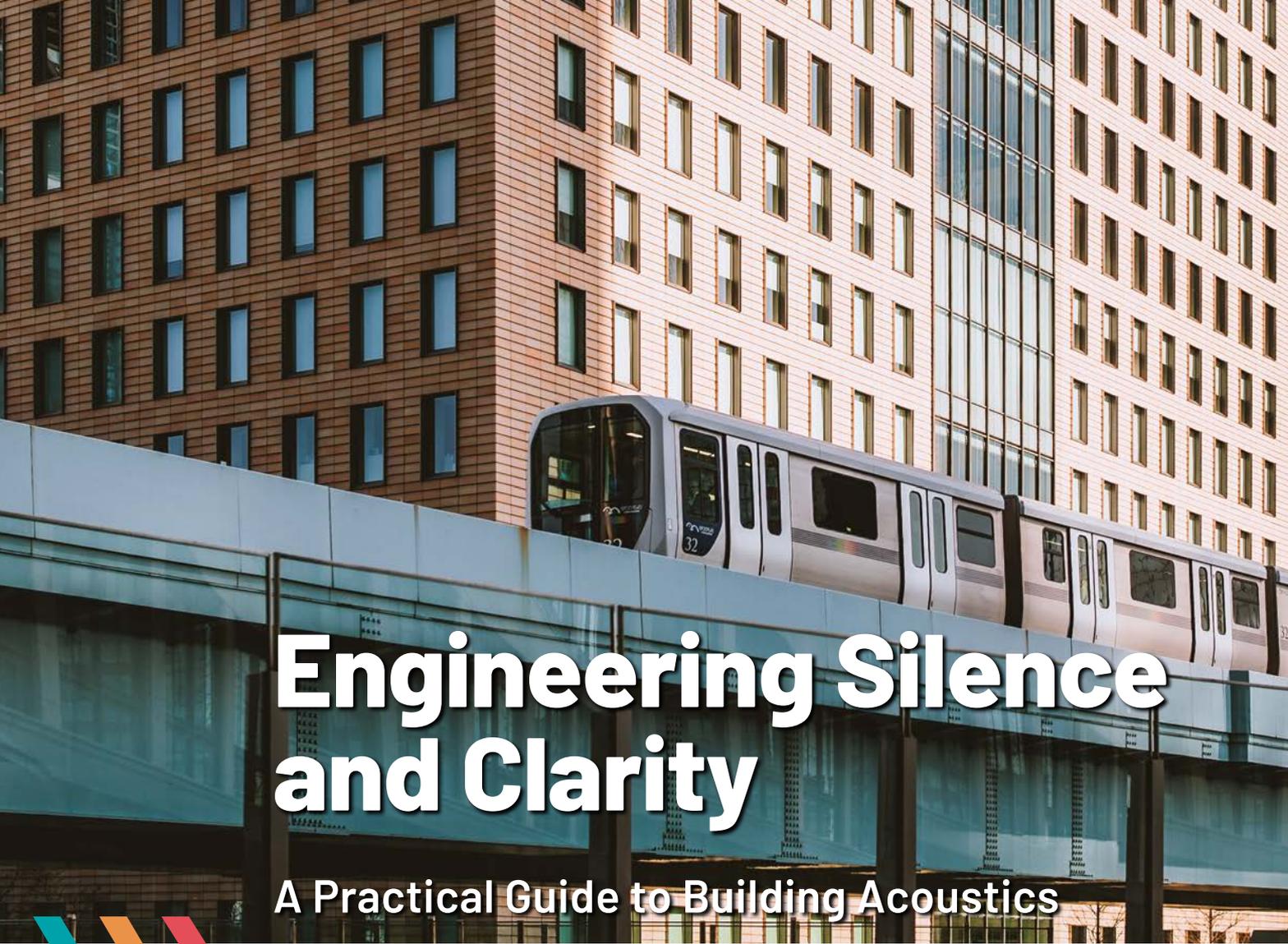
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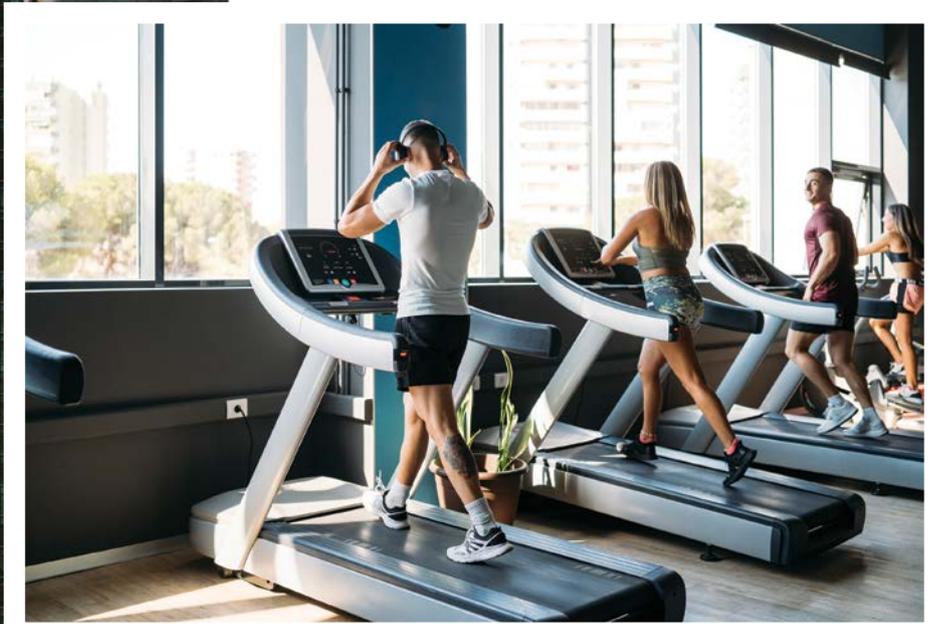
In the design of high-performance buildings, architects and engineers routinely focus on what occupants can see, daylight, materials, spatial organization, and finishes. Yet what occupants hear, or struggle to hear, can be just as influential in determining comfort, productivity, health, and overall building quality. Acoustic performance is not a specialty concern reserved for theaters or concert halls; it is a fundamental component of successful buildings across nearly every occupancy type.

As buildings become more energy efficient, more densely occupied, and more structurally diverse, acoustic challenges are increasing. Exterior noise and vibration from traffic, rail lines, and aircraft intersect with interior sound sources, including speech, footfall, mechanical systems, and specialized occupancies such as fitness rooms. At the same time, expectations for acoustic comfort and inclusivity are rising, driven by greater awareness of neurodiversity, age-related hearing loss, medical rest and recuperation, and the developmental needs of young children.

This article explores how architects, engineers, and specifiers can design and deliver buildings with high-quality acoustic indoor environments. It addresses the assessment and control of exterior noise and vibration, interior sound management strategies, acoustic performance goals across common building types, and the role of codes, standards, and rating systems, particularly LEED v5 and WELL v2 in guiding design and specification decisions.

### Why acoustic performance matters

Sound has a measurable and direct impact on human performance and well-being. Poor acoustic environments, characterized by excessive background noise, high reverberation, tonal mechanical noise, or intrusive vibration, can lead to fatigue, stress, reduced concentration, communication errors, and occupant dissatisfaction. In educational and healthcare settings, poor acoustics can directly undermine core programmatic objectives, affecting learning outcomes, patient recovery, and staff effectiveness.



Fitness rooms are a primary source of noise and vibration issues in buildings.

PHOTO COURTESY GETTY IMAGES

Research consistently demonstrates that even modest improvements in acoustic conditions can improve speech intelligibility, task performance, and perceived comfort. Reduced reverberation enhances comprehension, particularly for complex or unfamiliar information. Controlling background sound reduces distraction and cognitive load. Adequate sound isolation supports privacy, rest, and recovery, outcomes that are increasingly valued by building occupants and owners alike.

Acoustic quality is also a key element of inclusive design. Neurodivergent individuals, including people with autism, ADHD, PTSD, or auditory processing sensitivities, may be particularly affected by unpredictable noise, echoes, or sudden sound events. Older adults with hearing loss often struggle more with excessive reverberation and background noise than with the level of loudness alone, as reflected sound interferes with speech clarity and elevated noise masks specific speech pronunciation. Young children require optimized acoustic conditions to support speech and language development, especially in classrooms and childcare settings. Designing for these needs improves physical and mental well-being for everyone.

### **Understanding noise, sound, and vibration in buildings**

Effective acoustic design requires an understanding of how sound and vibration are generated and transmitted.

Airborne noise includes speech, music, traffic, aircraft, and many mechanical sources. It travels through the air and can transmit through walls, ceilings, floors, glazing, and doors if assemblies are not properly designed, detailed, and sealed.

Structure-borne noise and vibration occur when mechanical equipment, rail systems, elevators, or impact activities transmit energy into the building structure. This energy can propagate through the structural framing and floor slabs and re-radiate as audible sound in locations far from the original source.

Reverberation refers to the persistence of sound within a space due to reflections from hard surfaces. Excessive reverberation reduces speech intelligibility, increases perceived noise levels, and can make spaces feel chaotic or fatiguing.

Background noise includes steady-state sounds from HVAC systems, electrical equipment, and exterior sources. While excessive background noise is disruptive, environments that are too quiet can compromise speech privacy and occupant comfort, particularly in offices and healthcare settings.

Managing these conditions requires coordinated decisions across site planning, enclosure design, interior assemblies, finishes, furnishings, and mechanical systems.

### **Assessing and controlling exterior noise and vibration**

Exterior noise and vibration should be evaluated as early as possible, ideally during site selection or pre-design. Once building massing, structural systems, and program

adjacencies are established, mitigation options become more limited and costly.

Common exterior sources include roadway traffic, rail transit, aircraft, industrial activity, and emergency services. In some contexts, vibration from rail lines or heavy vehicles may be as problematic as audible noise, particularly for residential buildings, classrooms, healthcare facilities, laboratories, courts, performing arts spaces, and other vibration-sensitive occupancies.

Early assessment may include noise contour mapping, vibration screening criteria, and predictive modeling. These tools help inform site layout, building orientation, and envelope performance requirements, and can prevent costly redesign later in the project.

Design and specification strategies include:

- Maximizing distance from noise and vibration sources through site planning
- Strategic building orientation and massing
- Earth berms, sound walls, and landscape buffers
- Enhanced exterior wall and roof assemblies with increased mass and air-tightness
- High-performance glazing with appropriate acoustic performance ratings
- Structural isolation or vibration mitigation measures in foundations

While high-performance envelopes often reduce exterior noise intrusion, quieter interior environments can increase occupant sensitivity to interior noise transmission, reinforcing the need for careful and holistic acoustic design throughout the building.

### Managing interior noise sources

Interior acoustic challenges typically involve a combination of speech, mechanical systems, and impact noise.

#### *Speech and activity noise*

Speech is the most common interior noise source and a frequent cause of complaints. In open offices, classrooms, restaurants, and multi-family housing, uncontrolled speech noise can quickly dominate the soundscape and reduce the usability of the space.

Amplified sound from home theater and gaming systems, music playback systems, and conferencing systems is a related issue. This is the most frequent source of complaints and legal disputes in multi-family residential buildings. It is also a significant concern in mixed-use projects, especially between residences and retail/restaurant spaces.

Effective strategies include:

- Limiting reverberation through sound-absorptive ceilings and wall treatments



- Zoning quiet and active functions to reduce sound spillover between spaces
- Providing adequate sound isolation for enclosed rooms requiring privacy
- Employing sound masking systems where appropriate

The goal is not silence, but predictable and supportive sound environments that enable communication without distraction.

#### *Mechanical and electrical systems*

HVAC and plumbing systems are frequent sources of background noise. Common issues include excessive airflow noise, tonal fan noise, vibration transmission through the structure, and intermittent cycling sounds that draw occupant attention.

Mitigation requires early coordination between acoustic and mechanical design:

- Proper equipment location, sizing, and selection
- Careful layout of low-velocity ductwork and air distribution strategies
- Vibration isolation for mechanical equipment
- Lined ducts or sound traps where required
- Careful detailing of penetrations and structural supports

Addressing these issues during design is significantly more effective and less expensive than post-construction fixes.

#### *Impact noise and specialized uses*

Impact noise from footsteps or dropped objects is a common concern in multi-family housing and hotels. Fitness rooms



**Left:** Quality acoustic design is critical in learning environments.

PHOTO ©XAVIERARNAU | GETTY IMAGES

**Below:** Careful attention to acoustics in healthcare facilities supports patient recuperation and reduces error risks with staff.

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introduce additional challenges due to high-impact activities and low-frequency vibration from weights and equipment.

This is not a trivial noise concern. In one case, noise from a fitness center was impacting an apartment seven stories above. This led to a years-long legal dispute that resulted in costly retrofits to remediate.

Mitigation strategies may include floating floors, acoustic underlayments, resilient ceiling assemblies, structural isolation, and programmatic separation. These conditions should be identified early, as structural changes become difficult later in design.

## Acoustic performance by building type

### *Educational facilities*

Clear communication is essential in schools. Young learners are particularly vulnerable to poor acoustic conditions, and teachers benefit from reduced vocal strain. While voice amplification systems can help, they do not replace the need for good room acoustics as students need to hear each other as well as the teacher, and intelligibility of amplified speech can be impacted by poor acoustic environments. Schools also contain specialty spaces that require careful attention. For example, there have been many workers compensation claims from music instructors who

experienced hearing loss due to poor acoustic design of music rooms.

Standards such as ANSI S12.60 and the *International Building Code (IBC)* require:

- Reverberation times generally not exceeding approximately 0.6–0.7 seconds
- Ambient noise levels not exceeding 35 dBA

Meeting these targets typically requires acoustic ceilings, selective wall absorption, controlled HVAC noise, and well-insulated building envelopes.

### *Offices and workplaces*

Workplaces must support focused work, collaboration, and virtual communication. Open-plan offices present challenges related to speech distraction and privacy, particularly as hybrid work increases the frequency of video meetings.

Effective office acoustics balance absorption, isolation, sound masking, and mechanical noise control while accommodating a wide range of occupant noise tolerance.

### *Healthcare facilities*

In healthcare environments, acoustics influence patient outcomes, staff performance, and confidentiality. Quiet

patient rooms support rest and healing, while exam and consultation rooms require strong speech privacy.

Guidelines from the Facility Guidelines Institute (FGI) and the World Health Organization (WHO) emphasize low noise levels, sound isolation, and careful control of alarms and equipment noise.

### *Multi-family housing and hospitality*

In residential buildings, acoustic performance is a key indicator of quality. Codes typically require minimum Sound Transmission Class (STC) and Impact Insulation Class (IIC) ratings of 50 (or 45 when field tested), but occupant expectations often exceed these minimums, particularly in newer, high-performance buildings.

Meeting expectations may require enhanced assemblies (STC/IIC 55 to 60), careful detailing, and isolation of plumbing and mechanical systems. This is especially critical given the potential of legal disputes in residential projects and guest complaints in hotels.

### *Restaurants and social spaces*

Restaurants and hospitality venues must balance energy and ambiance with speech intelligibility. Excessive noise is a common complaint and can shorten dwell times and reduce customer satisfaction. It is also critical to address sound transmission and propagation to neighboring and adjacent sound-sensitive spaces.

Distributed absorption, thoughtful material selection, and careful control of music and mechanical noise are essential to successful designs.

## **Codes, standards, and rating systems: LEED v5 and WELL v2**

Acoustic design is guided by a combination of codes and standards, including:

- IBC Section 1207
- ANSI S12.60 for classroom acoustics
- FGI Guidelines for healthcare facilities
- U.S. Courts Design Guide and Unified Facilities Criteria

Voluntary rating systems also guide acoustic design:

LEED v5 provides refined guidance across building types. For schools, it aligns closely with ANSI S12.60 and IBC requirements. For offices and healthcare facilities, LEED v5 allows flexibility through a combination of absorption and sound isolation. It also emphasizes acoustic zoning, early coordination, and informed assembly selection.

WELL Building Standard v2 addresses acoustics through its sound concept, emphasizing mechanical noise control, sound isolation and speech privacy between functional spaces, and restorative quiet spaces for stress reduction.



WELL reinforces acoustics as a core component of occupant health and well-being rather than a secondary comfort issue.

Specifiers should understand how these requirements interact and where project-specific performance targets exceed minimum code requirements.

## **The role of the acoustical consultant**

High-quality acoustic environments rarely result from prescriptive assemblies alone. Acoustical consultants provide specialized expertise in building physics, materials, and perceptual acoustics, helping teams translate performance goals into constructible solutions.

Early engagement enables:

- Strategic space planning and zoning
- Informed assembly selection
- Coordination with structural and mechanical systems
- Predictive modeling and performance verification

The acoustical consultant will review the project details and specifications, including the spacing of wall framing and component assemblies, as documented in the construction documents. Without this early attention, projects may fail field acoustical performance tests of demising walls and floor-ceiling assemblies. This can lead to costly retrofits, such as the removal of gypsum board, the installation of resilient elements, and the reinstallation of multiple additional layers of gypsum board.

This consultant's role is increasingly important as new construction systems gain popularity. Mass timber and hybrid structural systems pose unique challenges due to their lighter weight and lower inherent damping than concrete or steel.

Designers also frequently leave mass timber ceilings, walls, and structural elements exposed to highlight aesthetic and biophilic qualities. While visually compelling,



Left: Thoughtful acoustic design in restaurants.

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Below: While a beautiful contribution to biophilic design, mass timber requires early acoustic consideration.

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exposed wood surfaces are acoustically reflective and can significantly increase reverberation if not balanced with absorptive elements.

Successful acoustic design in mass timber buildings often requires:

- Strategic placement of absorptive materials compatible with exposed wood
- Enhanced floor/ceiling assemblies for impact noise
- Supplemental mass or resilient layers where sound isolation is critical
- Careful connection detailing to limit vibration transmission
- Early interdisciplinary coordination

Similar considerations apply to modular construction, prefabrication, and exposed structural systems. In these cases, acoustic performance must be integrated into the

building system from the outset, and acoustic consultants are well-equipped to guide this effort.

### Conclusion

Acoustic design plays a quiet but powerful role in shaping how buildings perform and how occupants experience them. From controlling exterior noise and vibration to managing interior sound sources and supporting diverse user needs, acoustics influence how people learn, work, rest, and heal.

By integrating acoustic performance goals early, coordinating across disciplines, and making informed specification decisions guided by codes, standards, and rating systems such as LEED v5 and WELL v2, architects and engineers can deliver buildings that truly perform. Designing with the ear in mind is not an optional enhancement; it is a core component of building quality.

## additional information

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### KEY TAKEAWAYS

Acoustic performance directly affects health, learning,

productivity, and privacy across building types. Effective design requires early evaluation of exterior noise and vibration, coordinated control of interior sound sources, and informed assembly selection. Codes, standards, and rating systems such as LEED v5 and WELL v2 guide performance targets, while acoustical consultants help translate goals into constructible solutions.

### MASTERFORMAT NO.

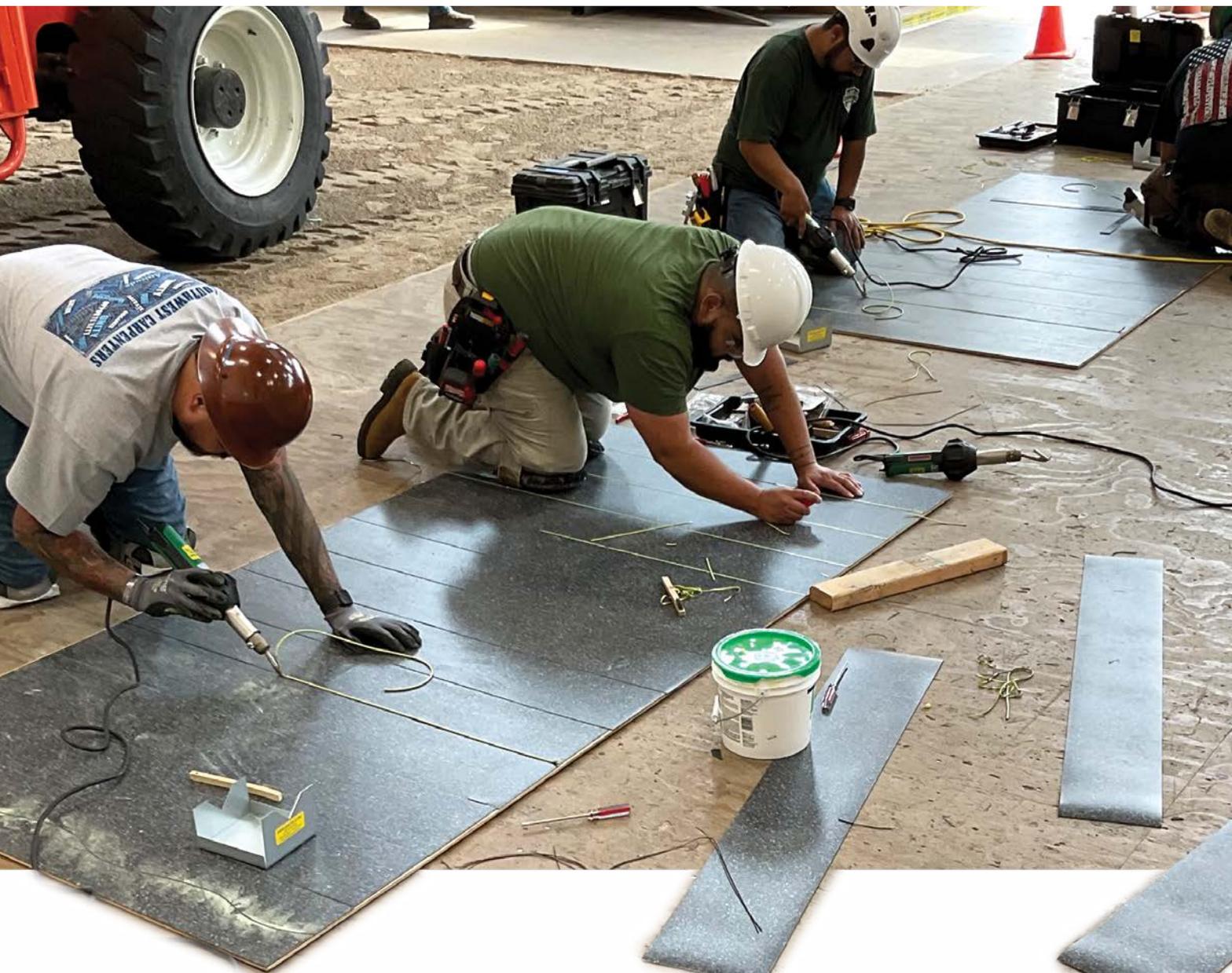
09 51 00—Acoustical Ceilings 09 83 00—Acoustic Treatment

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C3030—Ceiling Finishes C3040—Wall Finishes  
C3020—Floor Finishes

### KEYWORDS

Division 09 Acoustic performance



# Inside a Perfect Seam

## The Art and Science of Heat Welding Vinyl Floors

By David Gross  
PHOTOS COURTESY  
INSTALL

Heat welding resilient or vinyl flooring seams may appear to be a straightforward task that any installer can perform, but in a healthcare environment, this skill is anything but incidental.

Joining two sheets of flooring material with a perfect heat weld that is visually imperceptible and impervious to moisture and dirt collection requires a specialized set of practiced skills. From fresh-edge cutting, net-fit tolerances, and

controlled grooving, to post-weld skiving and flash coving, every step critically impacts the integrity of the final seam and flooring performance and not just the aesthetics. Healthcare environments leave no room for errors.

For specifiers, understanding what it takes to properly execute heat-welded seams is essential to selecting a qualified installer. This overview helps specifiers understand key aspects of heat



Figure 1

welding. It also highlights areas where installers might make mistakes or skip best practices. Specifiers need this knowledge to ensure their floors and installers meet the high standards required in healthcare.

### It starts with a fresh edge

The first step for an installer in achieving a successful heat-welded seam is cutting a fresh edge on the material before it is adhered to the floor. Sheet goods delivered to a jobsite typically arrive on a 1.83 m (6 ft) wide roll that can be up to 0.61 m (2 ft) in diameter, and the roll is commonly stored upright on its end rather than flat on the floor. A vinyl roll can weigh well over 113 kg (250 lb), depending on the product type. The weight can compress the edge of the roll in contact with the floor, causing damage and altering its shape. The material may be thinner along that edge or bowed in a concave or convex direction. The weight of a roll that size also affects structural loading, depending on the structural floor framing system.

To remove these irregularities, the best practice is to use a straight edge or edger tool to remove roughly 12.7 mm (0.5 in.) of material along this

edge, giving it a clean, uniform shape and thickness. This first step in setting up the conditions for a strong, clean weld is also surprisingly often missed by installers who either do not know they should do it or skip it to save time on the job. In both instances, failing to cut a fresh edge puts the heat-welded seam at risk from the start, as the installer will then be attempting to join two unmatched edges.

If one edge of the material is thicker than the other, or if it is bowing in places, this can lead to misalignment of the flooring material and create a cascading series of issues affecting subsequent grooving, welding, and skiving steps. Installers who take the time to cut a fresh, true edge (and know that this is best practice in the first place) set the material up for success from the start.

### Minding the gap

After cutting a fresh edge and before grooving, the resilient or vinyl sheet flooring must be installed with a “true net fit” to ensure the weld rod makes optimal contact with the flooring material.

True net fit describes the actual fitting of the sheets so that their seam edges are freshly cut, aligned, and placed to the precise spacing

Flooring installers who also possess specialized healthcare training recognize that a failed seam is not just an aesthetic or warranty issue but a potential infection reservoir.

**Figure 1:** Best practice for skiving the weld is to perform two passes, with the first pass removing half to two-thirds of the excess weld material.



Heat welding requires sufficient sidewall and bottom contact for the weld rod to properly fuse.

specified by the manufacturer (typically around 1/32 of an inch). This controlled fit avoids both excessive gaps and overly tight joints. True net fit also ensures sufficient material remains after grooving, which is the next step taken to create the U-shaped channel to accept the weld rod. Most manufacturers specify a half to two-third deep groove centered to the adjoining sheets. Strict adherence to this tolerance is essential for the heat weld to create the structural integrity of the seam.

When seams are heat-welded across gaps that are too wide, the subsequent grooving operation is difficult to center, resulting in insufficient sidewall and bottom contact for the weld rod to properly fuse. In these cases, the weld lacks an adequate bonding area, significantly compromising seam strength and longevity, as well as aesthetics.

Conversely, seam edges that are too tight when the material edges are butted together introduce a different set of problems. Some untrained installers believe tight installation preserves material mass, but more often it produces peaked seams that make it difficult for mechanical groovers to maintain a consistent groove depth. The result

increases the risk of tool runoff, uneven groove geometry, and damage to the surrounding seam edges, all of which negatively affect weld quality.

Beginning an installation with a true net fit that follows the manufacturer's written specifications sets up all seams for more precise grooving, welding, and finishing.

### Skiving: It takes two

Once the flooring is properly cut and fitted, the installer grooves the seam to receive the weld rod, then melts and fuses it into the channel using a heat-welding gun. When seams are correctly fitted, uniformly grooved, and welded with proper heat and travel speed, the weld rod achieves a strong bond along the bottom and the sidewalls of the groove.

Since the weld rod is cylindrical, a portion of the rod remains above the sheet flooring surface after welding (Figure 1, page 21). This excess material is then skived, or trimmed down, so the weld rod becomes level with the two sheets that it is joining to create a flat and uniform finished surface.

Certified installers are taught that the best practice for skiving the weld rod is to perform it in two distinct passes, resulting in a weld "on-plane" with the flooring surface. During the first pass, installers attach a spacer to the skiving tool. This first pass removes approximately one-half to two-thirds of the excess weld material. Precision in this step is critical due to the volume and geometry of the material. Slicing the weld rod requires a measurable downward force, regardless of blade sharpness. This force inherently causes a slight upward deflection, or lift, in the seam, which the installer must accurately account for when performing the first pass.

After removing the bulk of the material in the first pass, the force required for the second pass will be significantly reduced. This lighter touch creates less lift during the final pass, leaving the weld rod flush with the flooring surface. The resulting seam should be visually imperceptible when the weld rod is properly coordinated with the installed material using the two-pass method, creating no visible distinction and no raised or recessed area at each seam executed this way.

Some installers without specialized heat-weld training shortcut the skiving step by performing only one pass with the skiving tool. To compensate



Installers who take the time to cut a fresh, true edge set up the material for success at the start of the process.

for skipping a pass, installers often apply excessive pressure to the skiving tool and remove too much material at once, believing that a single pass is more efficient. The single pass method creates a seam with drastically more lift during cutting. When it settles back into place, the trimmed weld sits below the finished surface. The resultant concave seam profile readily traps dirt, contaminants, and moisture. Such seams typically fail visual acceptance criteria and result in difficult, if not impractical, repair scenarios that can disrupt the daily operations of the healthcare facility. In worst cases, poor skiving can go undetected and become a problem as the floor is used, with the seam collecting dirt and becoming difficult to clean.

Ironically, single-pass skiving does not yield meaningful time savings for the installer or the project as a whole. Any perceived efficiency is quickly negated by increased rejection risk, corrective labor, damage to reputation, and reduced client confidence.

Compared with following best practice and performing two-pass skiving, the time commitment is minimal, especially compared with rework time.

### **And then, flash coving**

For a healthcare facility, flooring that fails due to inadequate knowledge and deficient skills in heat-

welded seam construction can result in disruption of patient services and costly downtime. Heat welding is a common and critical component of a typical healthcare flooring installation.

Flash coving (also known as integral base installation) is even more demanding in terms of precision and technique than skiving, which requires its own set of highly specialized skills. Flash coving is a type of installation that uses the heat-welded seam principles of flat seams and applies them continuously along the flooring material up the wall for 102 mm (4 in.) or more. The resilient flooring is therefore serving not only as the flooring material but also as the on-cove base material.

Flash coving installations require a host of additional considerations, including maintaining a visually consistent, straight wall line termination, ensuring the material is firmly adhered to the radius at the floor-wall junction, addressing the special demands of inside and outside corners, and navigating floor or wall penetrations. It is highly visible, unforgiving of shortcuts, and notoriously difficult to repair. This type of installation is very common in the most sensitive and high-stakes healthcare spaces, such as operating rooms, ICUs, and laboratories where cleanability, durability, and long-term performance are critical.

The second article in this two-part series on heat welding will explore flash coving in greater detail.

### Tips for specifying healthcare flooring contractors

Successful flooring outcomes for healthcare projects go well beyond selecting the right materials. Specifiers generally do not do the actual vetting, but they do control the criteria and standards installers must meet. General contractors are more generally the ones hiring the installers.

One of the most recognized and respected certifications for healthcare installers, in addition to flooring acumen, is Infection Control Risk Assessment (ICRA). ICRA training teaches installers how construction activities, even those as localized as flooring preparation and seam welding, can introduce contaminants and pathogens into healthcare environments. ICRA-certified installers understand how to classify risk areas, establish contaminant barriers, control airflow and dust, manage debris removal, and coordinate their work with infection prevention teams. ICRA training includes requirements and strategies to perform installations in occupied facilities without compromising adjacent patient care spaces, a skill that is essential amid the boom in expansion and renovation within our aging healthcare infrastructure.

Flooring installers who also possess specialized healthcare training bring a fundamentally

different mindset to the jobsite. They recognize that a failed seam is not just an aesthetic or warranty issue but a potential infection reservoir. This awareness influences every step of their installation process, from substrate prep and seam geometry to heat welding and flash coving. Certified installers have taken the extra steps to demonstrate a commitment to industry's established standards, and their certification acts as an insurance policy for the installation.

Ultimately, heat-welded seams that perform best in healthcare environments are the result of deliberate skill, proper training, and disciplined execution. By looking beyond product selection alone and establishing training and certification requirements in the "Quality Assurance" description, setting a facility type certification level, and clearly identifying healthcare-specific experience, specifiers can better align design intent with field execution. The reward is flooring that supports infection control goals, withstands rigorous cleaning, and delivers long-term performance without surprises after turnover. 

Author's note: This article is one of a two-part series on heat-welding techniques used in healthcare, resilient, and vinyl flooring installations. Part two will explore flash coving, providing specifiers with an introduction to best practices, cautions on where it can go wrong, and tips for selecting an installer with the right skills for success. For additional information, refer to manufacturer recommendations and/or ASTM F1516.

## additional information

### AUTHOR



**David Gross** is the executive director of INSTALL, the leading organization for floorcovering installation training and certification in North America at [INSTALLFloors.org](http://INSTALLFloors.org). Prior to this role, Gross was a full-time instructor for the Eastern Atlantic States Carpenter's Apprenticeship

Training Fund, where he achieved Level III Advanced Instructor Certification. He holds a bachelor's degree in economics, an MBA, and is a BCSP Certified Safety Professional, with more than 30 years of hands-on floor installation experience.

### KEY TAKEAWAYS

Heat-welded seams in healthcare flooring demand specialized training, strict tolerances, and disciplined execution—from fresh-edge cutting and true net fitting to controlled grooving

and two-pass skiving. Shortcuts compromise cleanability and durability, creating infection risks. Specifiers play a critical role by selecting certified, healthcare-trained installers who can meet the performance standards these environments require.

### MASTERFORMAT NO.

09 65 00—Resilient Flooring

### UNIFORMAT NO.

C30—Interior Finishes  
C3020—Floor Finishes

### KEYWORDS

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Flooring  
Heat-welded seams



# Climate-ready Windows

## What Architects Need to Know

**The built environment is constantly evolving.** Climate concerns, stringent energy codes, and growing consumer expectations continue to reshape how buildings are specified and constructed. Each component of a building, produced by multiple manufacturers, must fit together like puzzle pieces to ensure compatibility and performance across the entire structure.

Each building material has its own story, from conception and R&D to production, before it is ultimately relied upon by owners and occupants to perform for decades. Among these steps, the material's composition is one of the most critical factors for longevity.

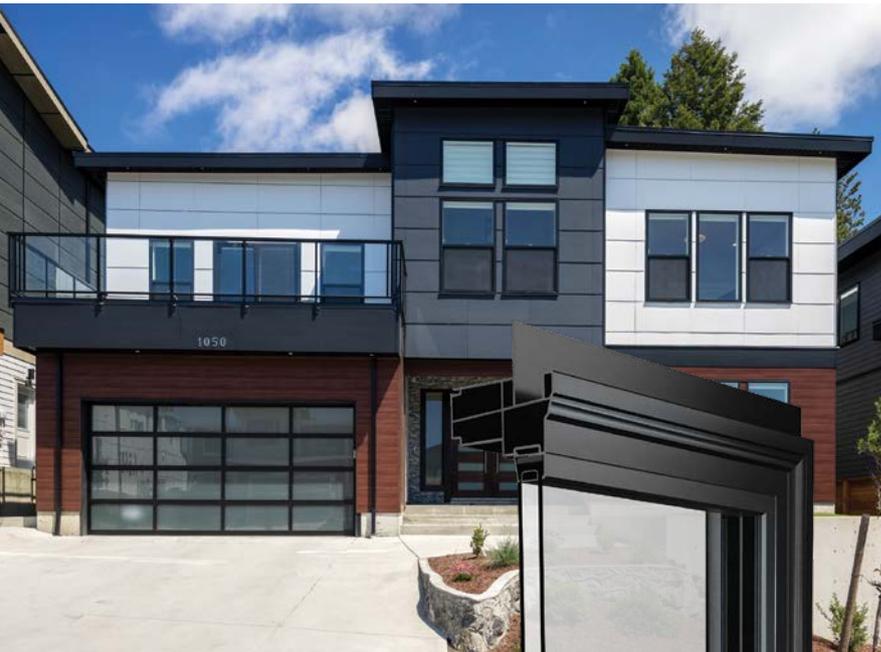
For polyvinyl chloride (PVC) window and door systems specifically, material science plays a major role in a system's long-term viability and durability. For 21<sup>st</sup>-century windows and doors, there is more to the approach than meets the eye.

### **Climate change considerations**

Climate change and ever-increasing global temperatures have placed greater demand on research aimed at advancing PVC formulations. The ones previously used to manufacture windows and doors are not as effective as they once were. The environment is changing, making higher-performing, longer-lasting windows essential.

By Paul Adams and  
Dennis Cox

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DECEUNINCK NORTH  
AMERICA



**Above:** Black laminated polyvinyl chloride (PVC) windows on a home in British Columbia.

**Right:** Solid black window features advanced pigments to reduce heat absorption and vented profiles to regulate temperature.



In addition, from a sustainability perspective, according to an article published by the World Economic Forum, “The building value chain is responsible for 37% of total carbon emissions globally, involving multiple harder-to-abate sectors and needs to accelerate green transition from now on.”

This highlights the obligation for manufacturers to:

- Make products from more environmentally friendly materials
- Ensure products are recyclable at the end of service life
- Take steps to reduce carbon emissions

- Contribute to healthier buildings, *i.e.* products that reduce thermal transmittance, minimize HVAC/electric demands, offer natural daylighting, provide airtightness, etc.

Ultimately, windows must be designed for today’s performance demands, not for environmental conditions that existed two decades ago. Modern products are required to endure for at least 25 to 30 years, and at the end of their service life, they should be recyclable while retaining 90 percent of their original physical properties.

Further, the strain on modern buildings is greater than it once was because of a general trend of more extreme temperatures and conditions at both ends of the spectrum. For example, higher outdoor temperatures cause window systems to degrade more quickly. This is particularly a challenge with dark-colored window and door profiles, which are increasingly popular as exterior design trends evolve. With this in mind, window and door materials science teams are placing greater emphasis on developing new chemistries to combat these forces.

In addition, ENERGY STAR 7.0 revised its energy efficiency requirements per climate zone for windows to reflect this, with updated U-factor and solar heat gain coefficient (SHGC) values:

- Northern climate zone
  - U-factor: less than or equal to 0.22
  - SHGC: greater than or equal to 0.17
- North-central climate zone
  - U-factor: less than or equal to 0.25
  - SHGC: less than or equal to 0.40
- South-central climate zone
  - U-factor: less than or equal to 0.28
  - SHGC: less than or equal to 0.23
- Southern climate zone
  - U-factor: less than or equal to 0.32
  - SHGC: less than or equal to 0.23

These tighter criteria are designed to improve whole-building performance, as windows can account for up to 30 percent of residential heating and cooling energy use, according to the U.S. Department of Energy (DOE).

### **Colors, chemistries, and sustainable sourcing**

In addition to global climate considerations, the demand for new color pigments and their



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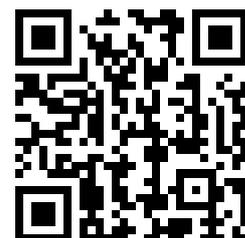
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Window impact testing at an in-house laboratory in Monroe, Ohio.



Material scientist preparing compounds for window and door production.

performance properties has required increased industry-wide research and development in pigment chemistry. For example, organizations have expanded research into paints and coatings originally developed for military vehicles and designed to reflect heat. The findings showed these same advancements can be applied to building materials and have even been employed to reduce heat gain in windows.

Reducing the overall carbon footprint is also an important focus, with many manufacturers committing to a more sustainable built environment. For this reason, plant-based additives sourced locally in the U.S. or imported from regions such as India or Brazil are being

incorporated into the formulation of PVC compounds. “Plants” are not traditionally part of the equation when considering the materials used to create windows or other plastic products, but these sustainable, organic materials can serve as lubricants and perform other vital functions in the production of PVC windows and doors.

Material compounds that ensure long-lasting color retention and low maintenance with durability against rotting, cracking, pitting, corroding, and peeling are also on the rise. The goal is to add dimensional strength, allowing window and door profiles to withstand decades of expansion and contraction without warping or surface degradation for the life of the product.

Once manufacturers ace material chemistry and commence initial production of the window and door systems, they must be rigorously validated through standardized testing, including long-term accelerated UV and thermal cycling, air infiltration, water resistance, and uniform load tests, ensuring they maintain structural integrity, thermal efficiency, and color retention throughout their service life.

### The big three: Testing for long-term in-service performance

Air infiltration testing, as defined by the Fenestration & Glazing Industry Alliance (FGIA),

measures air coming into a building around windows, doors, skylights, electrical outlets, walls, floors, and the roof as a result of differences in a building's internal and external air pressure. Typically conducted as the first test on a window, it establishes whether a system has the performance attributes necessary for real-world installation; failure at this stage renders subsequent water and structural testing irrelevant.

To pass the air infiltration test, no more than 0.14 L/s (0.3 cfm) of air may pass through the system under standard pressure conditions, which is a 1.75 psf (25 mph) wind load. High-performing window systems can achieve scores as low as 0.028 to 0.047 L/s (0.06 to 0.10 cfm).

Water resistance tests simulate rainfall and wind exposure to assess a window system's ability to prevent leaks. The test is similar to the air infiltration test, with the addition of a spray rack that continuously sprays water onto a window system. The test begins at a baseline of 2.62 psf (32 mph) winds applied to the exterior side of the window system and steadily increases from there. Negative pressure is also applied to the interior to pull water through the window.

Windows are exposed to 203 mm (8 in.) of simulated rain per square foot per hour. This exceeds any rate of rainfall ever recorded in a natural storm, according to the FGIA. That is, if a window is deemed compliant, it should be more than suitable for any real-world application with regard to rain and water resistance.

Industry average water resistance is 2.86 psf tested at 32 mph winds. Premier systems exceed this, achieving resistance from 3.75 psf to 15 psf—equivalent to 33 mph and 77 mph winds, respectively—providing significant long-term performance benefits in real-world applications.

Uniform load testing evaluates the structural integrity of window systems under extreme positive and negative static wind pressures. The test begins at 22.5 psf (equivalent to 94 mph winds) and progressively increases in 7.5 psf increments. High-performing systems remain intact even under wind loads exceeding 200 mph, demonstrating their ability to withstand substantial wind loads while meeting the specific criteria of the applicable product type and performance class.

It is important for manufacturers to share with customers the overall performance ratings of



Compounding towers are used to store, mix, and prepare raw materials used for polyvinyl chloride (PVC) window and door production.

their windows, including results that consider all three tests.

Importantly, a window may perform to a design pressure of 100, but if its water resistance measures only 30, the overall rating is 30, not 100 nor an average of the total scores. Providing transparency into the overall capability ratings is critical for customers to make informed decisions.

For architects and specifiers, understanding these test results is essential. It ensures window and door systems not only meet code but also deliver long-term durability and occupant comfort while mitigating potential risks for building owners and developers. Clear data helps architectural teams make confident product selections and avoid underperforming fenestration once installed.

### **Evolving consumer expectations**

Eco-conscious consumers are increasingly focused on energy efficiency and minimizing environmental impact in their homes. This is why modern plastics must be used in window and door extrusions, formulated with more sustainable materials compared to those used in the past.

Designers must anticipate the long-term needs of homeowners, ensuring products provide lasting ROI and peace of mind throughout the life of a home.

As far as tangible benefits for the homeowner are concerned, choosing thermally conscious windows helps to create comfortable interior



Engineer developing polyvinyl chloride (PVC) profile designs for window and door systems.

environments and inviting living spaces. In addition, by reducing thermal loss through a window frame, less energy is required to heat or cool a home. This is especially important with the rise in demand for thinner frames and sightlines. In these cases, advanced materials and design features help windows meet or exceed standards such as ENERGY STAR ratings and U-factor or solar heat gain coefficient (SHGC) requirements, resulting in measurable reductions in annual heating and cooling costs while decreasing the structure's environmental footprint.

### Architectural implications

As an architect, incorporating energy-efficient windows into designs offers significant benefits, including energy conservation and occupant

comfort. Since a significant portion of a home's energy loss can be attributed to heat transfer through windows, combining profiles with high thermal performance and the latest insulating glass technologies is a key specification consideration for architects.

Advanced glazing options, such as low-emissivity (Low-E) coatings and multi-pane systems, enhance thermal insulation and reduce the reliance on heating and cooling systems. Further, the integration of dynamic glazing systems (also known as smart glass), which can adjust its properties in response to environmental conditions such as light and heat, reduces the need for occupants to depend on artificial light sources.

These technologies not only contribute to energy conservation but also support sustainable building practices, aligning with respected green building initiatives such as LEED and net zero.

### Modern fenestration: A clear view

The evolution of PVC windows and doors is a sign of the times: one that reflects the critical roles that material science, thorough testing, and sustainability goals play in modern construction.

For architects and specifiers, it is clear. Industry-leading window and door systems provide greater compliance with today's stringent building codes while ensuring long-term performance, occupant well-being, and reduced environmental impact at the end of their lifecycle. 

## additional information

### AUTHORS



Paul B. Adams serves as the global vice president of materials innovation at Deceuninck North America and has been with the organization for nearly 20 years. Adams and his team conduct extensive research to create new formulas and advance the performance of extrusions used to create the windows and doors installed in millions of homes and buildings throughout North America.



Dennis Cox is product testing supervisor, Deceuninck North America, where he has been involved in fenestration testing, certification, R&D, and customer support for more than 35 years.

### KEY TAKEAWAYS

Material science, rigorous testing, and sustainability drive modern polyvinyl chloride (PVC) window and door performance. High-quality systems balance durability, energy efficiency, and aesthetic flexibility while withstanding extreme climates and reducing environmental impact. Architects and specifiers benefit from transparency in testing, enabling confident selection for long-term building performance and occupant comfort.

### MASTERFORMAT NO.

08 51 00—Windows

### UNIFORMAT NO.

B2010—Exterior Windows

B2020—Exterior Doors

### KEYWORDS

Division 08

PVC windows



# Why Stone Wool Delivers High-performance Acoustics

**Good acoustics are no longer “nice to have” in the built environment.** Sound is one of the most universal and ever-present components of our daily lives. People rely on it to communicate, collaborate, learn, heal, and connect. Yet when sound is not addressed, it can become a source of stress, distraction, and discomfort.

For architects, interior designers, and contractors shaping today’s commercial spaces, acoustics sit at the intersection of performance, well-being, and design intent. As open plans, exposed structures, and visually expressive ceilings continue to grow in commercial interiors, the question is no longer whether acoustics matter, but how to deliver high-performing acoustic solutions without compromising aesthetics.

This is where ceiling systems and strategic material selections—such as stone wool—enter the conversation.

## **Acoustics as a core component of occupant health and performance**

Acoustics affect everyone, every day. The sound environment directly influences how people feel and perform in a space, from homeowners and office workers to students, patients, and healthcare staff. Research consistently shows that excessive noise and reverberation negatively impact comfort, focus, communication, and productivity.

The impacts of poor acoustics are well documented in published research:

- Studies show that 50 percent of employees say noise prevents them from being productive. In educational environments, increased noise levels are linked to lower student performance on standardized tests.<sup>1</sup>
- Persistent background noise can elevate stress, contribute to fatigue, and reduce overall satisfaction with a space.

By Michael Thill  
PHOTOS COURTESY ROCKFON  
NORTH AMERICA



A stone wool ceiling tile with a concealed edge uses a biophilic color palette to support calm, focused office environments.

Layered ceiling elements combine visual interest and acoustic performance in this bank's retail interior.

PHOTO BY JOHN MAGNOSKI

- Poor acoustics cause sound to carry farther than intended, particularly in shared environments where privacy is needed for focused work or sensitive conversations.

In offices, schools, and healthcare facilities, these effects have real consequences. Performance, employee retention, and health can all suffer. With more than 90 percent of an organization's operating costs tied to employee efficiency, acoustic ceiling design can directly influence the bottom line.<sup>2</sup>

Yet acoustics are still often overlooked early in the planning and design process. Decisions made to support collaboration, sustainability, or visual openness can unintentionally create spaces that are noisy, distracting, or tiring to occupy. Open offices may reduce visual barriers but sacrifice speech privacy. Some finishes may support sustainability goals but reflect sound rather than absorb it. Exposed concrete decks and open plenums may look striking, but amplify reverberation.

The result? Spaces that look great on day one but struggle to support occupant well-being over time.

As awareness grows around the impact of sound on health and performance, particularly in workplaces, schools, and healthcare settings, designers are seeking smart, high-performing acoustic solutions that integrate seamlessly into

the ceiling plane rather than feeling like an afterthought.

### When it comes to acoustics, material selection is everything

More stringent acoustical criteria are shaping the way spaces are designed. Building owners increasingly recognize the link between acoustics and well-being and are willing to invest in solutions that support healthy indoor environments. Voluntary standards and rating systems are also reinforcing this shift, placing greater emphasis on indoor environmental quality (IEQ).<sup>3</sup>

The challenge lies in material selection. Not all acoustic materials perform equally, and not all solutions balance performance with aesthetics. Some products may offer visual appeal but limited sound absorption. Others may deliver strong acoustic performance but restrict design flexibility or visual rhythm.

That is why acoustics should be addressed early in the design process. Ceiling systems play a critical role. They can become one of the most effective tools for controlling sound in commercial interiors.

Designers and specifiers rely on standardized testing to understand how materials behave in real-world conditions. Two of the most common metrics in ceiling and wall design are Noise



Reduction Coefficient (NRC) and Sound Transmission Class (STC).

### Understanding NRC

NRC measures the amount of sound a material, such as a ceiling panel, absorbs. It is expressed on a scale from zero to one, where:

- Zero indicates little to no sound absorption (highly reflective)
- One indicates high sound absorption

High-performing absorptive ceiling panels with NRC ratings of 0.90 or higher can significantly improve the acoustic experience in open-plan offices, classrooms, retail spaces, healthcare recovery areas, corridors, meeting rooms, and lobbies.

The higher the NRC, the more sound energy is absorbed rather than reflected back into the space. Ceilings with NRC values below 0.70 often require additional absorption on walls to achieve acceptable acoustic comfort. Ideally, ceilings should handle absorption, while walls focus on blocking where needed.

Closely tied to NRC is the Ceiling Attenuation Class (CAC), which evaluates how effectively a ceiling panel limits sound transmission between adjacent spaces—particularly when partition walls stop short of the underside of the floor or roof deck.

“It’s important not to sacrifice necessary ceiling absorption for only moderate CAC ratings in the mid-30s. It leads to both insufficient absorption in rooms and disappointing privacy between rooms. Instead, specify the appropriately high ceiling NRC while also achieving privacy between rooms per building standards using full-height, STC-rated partitions or plenum barriers,” says Gary Madaras, PhD, Rockfon North America’s acoustic specialist.

For designers, NRC is the critical indicator of whether a ceiling system will meaningfully reduce reverberation and occupant noise.

### STC and sound insulation

While NRC focuses on absorption, STC measures a wall or floor/ceiling assembly’s ability to block sound from transferring between adjacent spaces.

“Building standards such as LEED, WELL, and Facility Guidelines Institute (FGI) require lab-tested partitions of STC 40, 45, and 50 between most commercial spaces. This assumes the construction extends from the floor to floor or roof. To maintain the intended sound insulation, the ceiling and plenum barrier location vertically above the wall combined must achieve the same level of performance,” says Madaras.

It is important to note that STC values are not additive. Adding another layer of drywall does not automatically result in a proportional increase

Ceiling tiles engineered for ISO Class 4 cleanroom environments support hygiene, cleanability, and acoustic performance in healthcare settings.

PHOTO BY  
CLAUDE-SIMON LANGLOIS



Stone wool ceiling panels provide a smooth, modern appearance with high sound absorption, achieving Noise Reduction Coefficient values of up to 0.90. Light-colored surfaces also support high light reflectance, contributing to visual comfort.

PHOTO COURTESY PERKINS & WILL

in STC. Assemblies must be tested as a system to confirm performance.

### Absorption versus blocking

Effective acoustic design typically involves a combination of strategies:

- Absorption—Materials such as ceiling panels, fabric systems, and porous products absorb sound and reduce loudness, reverberation, and echo
- Blocking (insulation)—Heavier, multi-layer, and full-height assemblies prevent sound from traveling between spaces

In most commercial environments, sound absorption is achieved primarily through ceiling systems, while walls and partitions provide the necessary blocking through mass and separation.

Materials such as stone wool excel in absorption. Due to the randomly oriented fiber structure, they are designed to capture and dissipate sound energy, reducing ambient noise and improving speech intelligibility. This makes them a powerful tool for creating quiet, comfortable spaces—particularly when integrated thoughtfully into ceiling systems.

### Rethinking ceiling systems and acoustic performance

Meeting today's high sound-absorption requirements can be achieved with a variety of ceiling solutions. Baffles have become a popular solution for open and visually expressive ceilings. Suspended vertically in open plenum spaces, they allow designers to maintain ceiling height, reveal structure, and create dynamic visual

rhythm. However, not all baffles deliver the same level of acoustic performance.

Stone wool is not commonly associated with metal baffle systems. However, integrating stone wool into baffle systems is not only possible, but it can also elevate acoustical performance without compromising architectural intent.

### The role of stone wool in ceiling performance

When incorporated into baffle designs, stone wool delivers:

- High sound absorption directly into the ceiling product
- Effective control of reverberation and background noise in open plenum spaces
- Proven acoustic performance backed by tested NRC values

Metal ceiling systems that integrate stone wool offer an opportunity to move beyond typical ceiling solutions. Rather than choosing between open ceilings and acoustic comfort, designers can achieve both.

### Proven performance, backed by testing

Stone wool is known for its high sound absorption capabilities and reliable performance across a range of applications. Its porous structure enables it to absorb sound effectively, contributing to calm, comfortable environments.

Consistent NRC values, supported by standardized testing, give designers confidence that specified performance will translate into real-world results. This reliability is particularly important in complex commercial spaces where acoustics play a critical role in occupant experience.

Stone wool delivers additional built-in benefits that support safe, healthy, and durable buildings. Its non-organic, moisture-resistant composition does not support mold or mildew growth, helping protect indoor air quality, while its inherently fire-resistant nature provides reliable occupant safety.

### Does acoustic performance limit design intent?

One of the most persistent concerns among designers is that acoustical materials will constrain creativity. Bulky panels, limited sizes, or repetitive layouts can feel at odds with expressive architectural visions.

This is where integrating stone wool into baffle systems changes the narrative.

#### *Supporting design flexibility through integration*

When stone wool is inserted within baffle systems, designers can:

- Maintain desired depths, heights, and lengths
- Preserve visual rhythm and ceiling articulation
- Achieve clean, intentional design expressions

Rather than adding acoustical treatments after the fact, acoustic performance becomes part of the design language itself. Baffles can be spaced, oriented, and proportioned to support both aesthetics and acoustics—without compromise.

#### *Aligning performance with aesthetics*

High-performing acoustics can work seamlessly with the design. With stone wool-integrated baffle systems, acoustics work with the architecture, supporting both function and form.

The result is a ceiling that does more than look good. It actively contributes to occupant comfort, speech clarity, and well-being while preserving the openness and visual interest designers seek.

### **Designing for the future of acoustic performance**

As expectations around occupant comfort continue to rise, acoustic performance will only

become more critical. Architects and designers are increasingly challenged to deliver spaces that support health, productivity, and experience while maximizing visual impact.

Design teams can create environments that truly perform by prioritizing performance early, understanding key acoustic metrics, such as sound absorption, sound transmission, and reverberation times, and exploring innovative materials such as stone wool ceiling systems.

Stone wool-integrated baffle systems, as an example, demonstrate that high-performing acoustics and compelling aesthetics are not mutually exclusive. Designers can maintain creative freedom while complying with requirements in standards and delivering the sound control modern spaces demand.

In the end, if people keep asking, “Can you repeat that?”—it is a clear sign the acoustics were not adequately addressed in the design. 🌈

#### **NOTES**

<sup>1</sup> Refer to “GSA Public Buildings Service, Sound Matters: How to achieve acoustic comfort in the contemporary office.”

<sup>2</sup> See “The Center for Health Design, Sound Control for Improved Outcomes in Healthcare Settings.”

<sup>3</sup> See [rockwool.com/north-america/advice-and-inspiration/blog/acoustics-requirements-in-building-codes/](https://rockwool.com/north-america/advice-and-inspiration/blog/acoustics-requirements-in-building-codes/)

## additional information

#### **AUTHOR**



Michael Thill has worked in the commercial ceilings industry since 2019, with a focus on metal ceiling systems. After supporting multiple metal ceiling product launches in product management, he now serves as specialty sales district sales manager at Rockfon North America, bringing practical insight into specification, installation methods, and field performance.

#### **KEY TAKEAWAYS**

Good acoustics are now fundamental to occupant comfort, health, and performance, making ceiling design and material selection critical in commercial interiors. As open plans and exposed ceilings become more common, acoustics must be addressed early to avoid noisy, fatiguing spaces. Understanding key metrics such as Noise Reduction Coefficient (NRC) and Sound Transmission Class (STC) helps designers balance sound absorption and privacy.

High-performing ceiling systems can control reverberation while preserving visual openness, demonstrating that acoustic performance and expressive architectural design can work together rather than in opposition.

#### **MASTERFORMAT NO.**

09 81 00—Acoustic Insulation

09 53 00—Acoustical Ceiling Suspension Systems

#### **UNIFORMAT NO.**

C1010.90—Interior Partitions

C1070.10—Suspended Ceilings

C1070.20—Plaster and Gypsum Board Ceilings

#### **KEYWORDS**

Division 09

Acoustic performance

Ceiling systems

Noise reduction coefficient (NRC)

Occupant well-being

Sound absorption

Stone wool



# Proactive Coordination

## The Quiet Driver of Successful Projects

By Ruben Caro, CSI

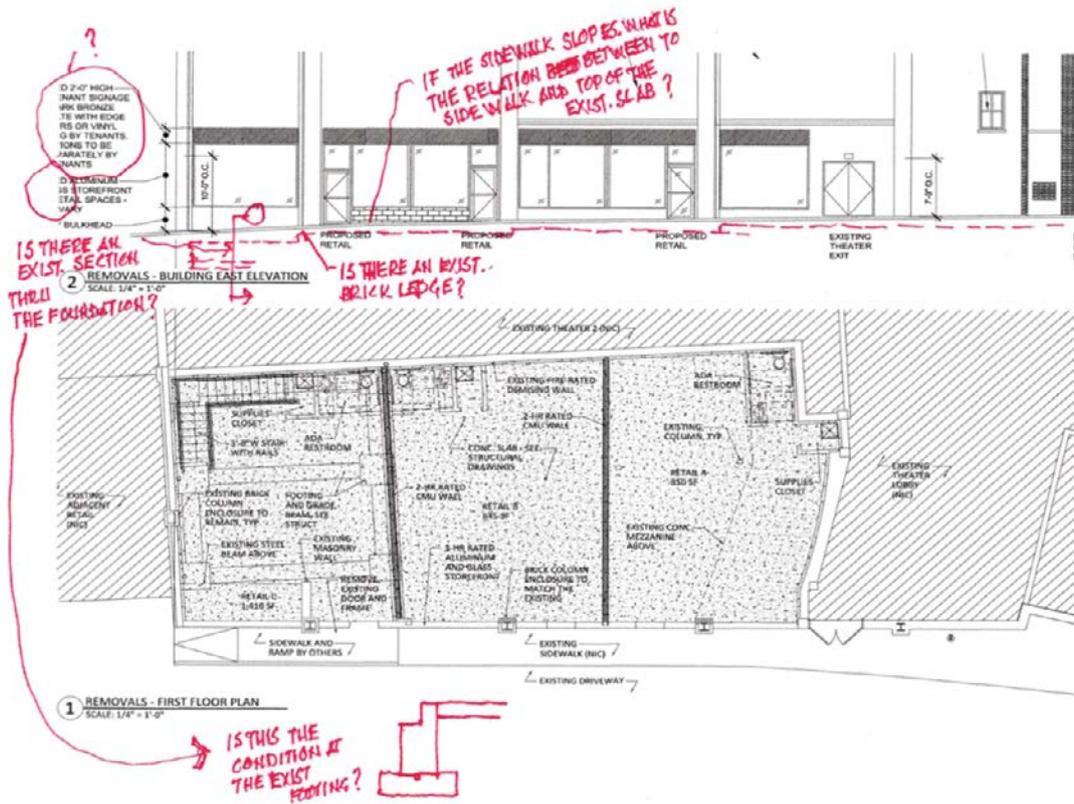
AI-GENERATED ILLUSTRATION

**Design professionals create documents that combine aesthetic and technical knowledge to turn concepts into reality.** A team is responsible for producing construction documents that provide the necessary information for the contractor to realize the building.

The process of designing and constructing buildings can be arduous, especially for large, complex projects. The American Institute of Architects (AIA) provides guidelines for the minimum requirements for the design, development, and construction phases for project completion. In addition,

most firms have their own “Production and Procedures Manuals” to help standardize the organization and development of the documents.

The Design Development (DD) and Construction Document (CD) Phases are where the nitty-gritty starts. These two phases are where the drawings and specifications, issued to the contractor for bidding and construction, are prepared. To have successful project coordination, not only in-house but between consultants, it is essential to develop a strategy on how to organize the project to ensure these



Early peer review and cross-disciplinary coordination during the construction document phases help surface these issues before they result in requests for information (RFIs) or field changes. ILLUSTRATION COURTESY BRENDAN YAN ARCHITECT

goals are met. Common statements heard about not doing a thorough coordination are as follows:

- “It is too early”
- “Not in this phase”
- “We have been keeping an eye on things during the project meetings”
- “We will do it during the bidding period”
- “There is no money left in the budget”

All these excuses are not valid reasons to postpone coordination or, worse, to ignore it altogether. A well-structured schedule for project coordination and peer reviews can minimize construction delays, errors, and omissions, reducing the likelihood of requests for information (RFIs).

### Common coordination pitfalls

Throughout the author’s career, they have been involved with numerous projects, including design development, construction administration, and peer reviews. The author finds that history does repeat itself. Here are a few examples consistently on projects:

- Notes such as “see structural for further information on stairs” and the structural drawing says, “see architectural for further information on stairs,” are a clear coordination failure.
- Not coordinating the interstitial space with MEP and structural systems can result in insufficient clearance for

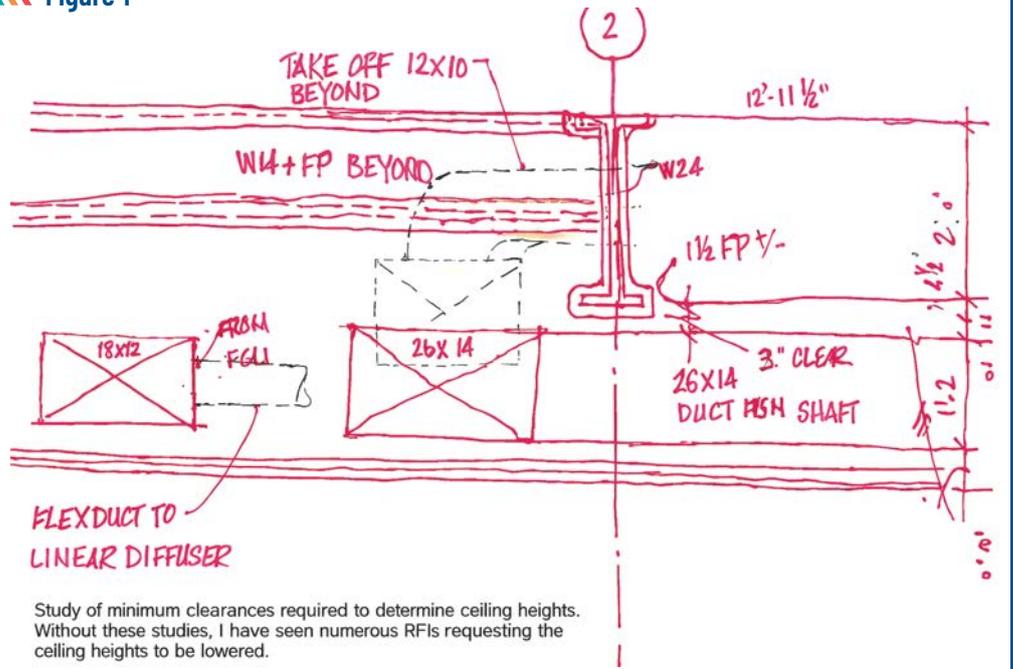
the crisscrossing of equipment. This may force ceiling heights to be lowered, which in turn can disrupt the planned alignment of adjacent building elements—such as door and window frames or horizontal wall joints—originally set to a specific module.

- Not reviewing the standard details to ensure they are in the project. This could cause RFIs from the field asking where the details are being used.
- Not reviewing the drawings to ensure all the materials on the plan, elevations, section, details, etc., have been labeled and properly identified. For instance, the author once asked someone what those lines, which were neither labeled nor referenced on the plans, represented. The answer was cabinets. Nothing should be left to interpretation.
- Coordinating the cross-bracing on the structural drawings with the location of the doors, windows, or other openings. Yes, this does happen.

Lack of coordination is a major cause of RFIs, change orders, and tension in construction. Good design practices and project management can help reduce these issues.

There are also tattle-tale signs in the documents that contractors and owners can easily detect to identify a lack of coordination. Things like the wrong city for the project’s jurisdiction in the general notes, standard details that have nothing to do with the project, a finish schedule indicating one material while a detail shows another, and references

**Figure 1**

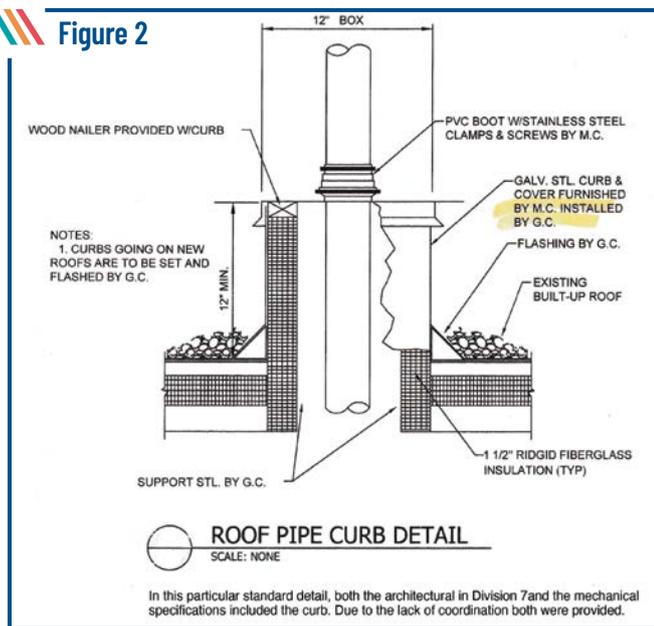


**Right:** Peer reviews help identify conflicts to prevent requests for information (RFIs) and field-driven changes during construction, which may turn into change orders and potential redesign of the interior spaces.

ILLUSTRATIONS AND IMAGES COURTESY RUBEN CARO

**Below:** This roof pipe curb detail illustrates how both the drawings and specifications can unintentionally include the same scope of work when coordination is lacking. Careful review during the construction document phase helps prevent duplication, clarify responsibility, and reduce requests for information (RFIs) during construction.

**Figure 2**



to details that do not exist. These discrepancies could be eliminated with proper coordination.

The AIA checklist guide is a very helpful tool for ensuring that the minimum requirements are met for both the design development and construction documents phases.

Just as architects do, contractors also have guidebooks for reviewing drawings and identifying potential change orders. During this process, contractors look for telltale signs of errors—most commonly discrepancies between the drawings and the specifications—which often translate directly into RFIs or change orders. Both typically require clarification during construction, adding time and potential costs to the project.

## Project meetings

A project kick-off meeting with all decision-makers should occur before the project starts to establish communication lines and project directory. All the participants will be required to know their objectives and all contacts. A clear understanding of how the project will be run must be established. Project coordination will be an essential part of these meetings. From the beginning, time should be allocated to document review across the different phases, not after the CDs have been completed and issued for bidding. The general coordination of the project should be an ongoing process between the engineers and the architects, with the CM included, when the CM is a team member. These meetings should identify the problems and provide solutions. During meetings, each member of the design team should be personally familiar with the project and be able to decide who will be responsible for implementing those decisions. After the meeting, the minutes should be distributed to each team member. Each team member should review the minutes for accuracy and return them to the author within five business days.

## Coordination of drawings, specifications, and general notes

The importance of coordinating drawings and specifications cannot be overemphasized. Open lines of communication must be established between the Project Architect and the Specification Writer. The specification writer should initiate a meeting early in the design development phase to discuss submission dates and information transfer. This will eliminate any possibility of starting the coordination process too late, which may lead to omissions.

**Figure 3**



Field-installed security ceiling had to be added to conceal exposed conduits and piping, illustrating the consequences of insufficient coordination between architectural and MEP systems. Early document review and peer coordination can help identify these conflicts before they require corrective work during construction.

All the materials being used on the project should be identified and included in the spec book. The Specification Writer should be informed of any additions or deletions to the materials to avoid missing sections or sections that do not apply. It is imperative that the specifications include only the materials that pertain to the project. Including superfluous language, materials or finishes in the spec that are not part of the project could lead to a tsunami of RFIs.

Time should also be allocated for peer reviews and included in the overall project schedule. The reviews should be performed at the end of the DDs and at the 90 percent CD phases. The reviewers should not be part of the project team, but a third-party senior technical member of the office. Once the review is complete, it should be shared with the design team, including the project manager and/or the project architect. It is inevitable that there will be questions and disagreements. Remember, the goal is for a technically sound building.

### Questions concerning finish schedule

Provide the following information as soon as possible to avoid delays:

#### *Exterior finishes*

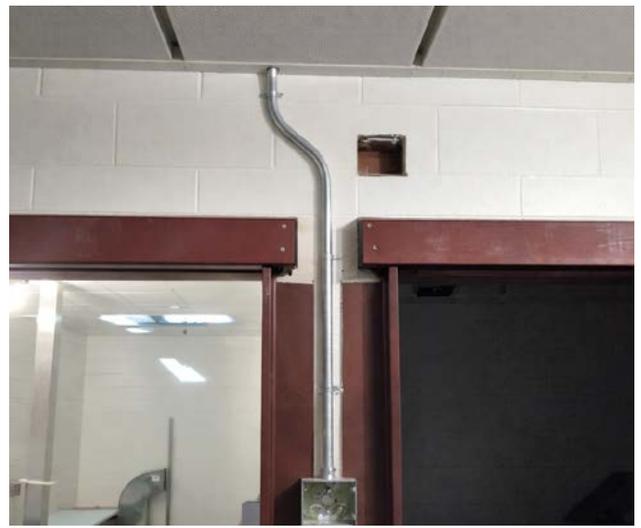
Cannot find the following finishes on the schedule

1. CONC-1
2. BRICK-2
3. MTL CLG-2
4. MT-5

Cannot find the following finishes on the building elevations

1. MT-3 The Alucobond panels are shown on the rendering on A201, but on the elevations.

**Figure 4**



Exposed conduit and uncoordinated penetrations highlight the impact of unresolved conflicts between architectural finishes and building systems. Thorough coordination and peer review during the construction document phase can reduce field modifications and avoid unnecessary requests for information (RFIs) or change orders.

2. TL-8 – TL-12 Please verify. Drawing A203 has a different set of numbers for the tiles.

#### *Interior finishes*

General comments:

1. PL-1 Schedule indicates “Desktop office.” Drawings indicate base and office partitions on Drawing A212.
2. Verify PT-14 and PT-13 Elevation 10/ A215

Cannot find the following finishes on the schedule

1. WD-1
2. PT-10
3. TL-6 (Last # 5B)
4. PT-8 (Last # 7)
5. CONC-1

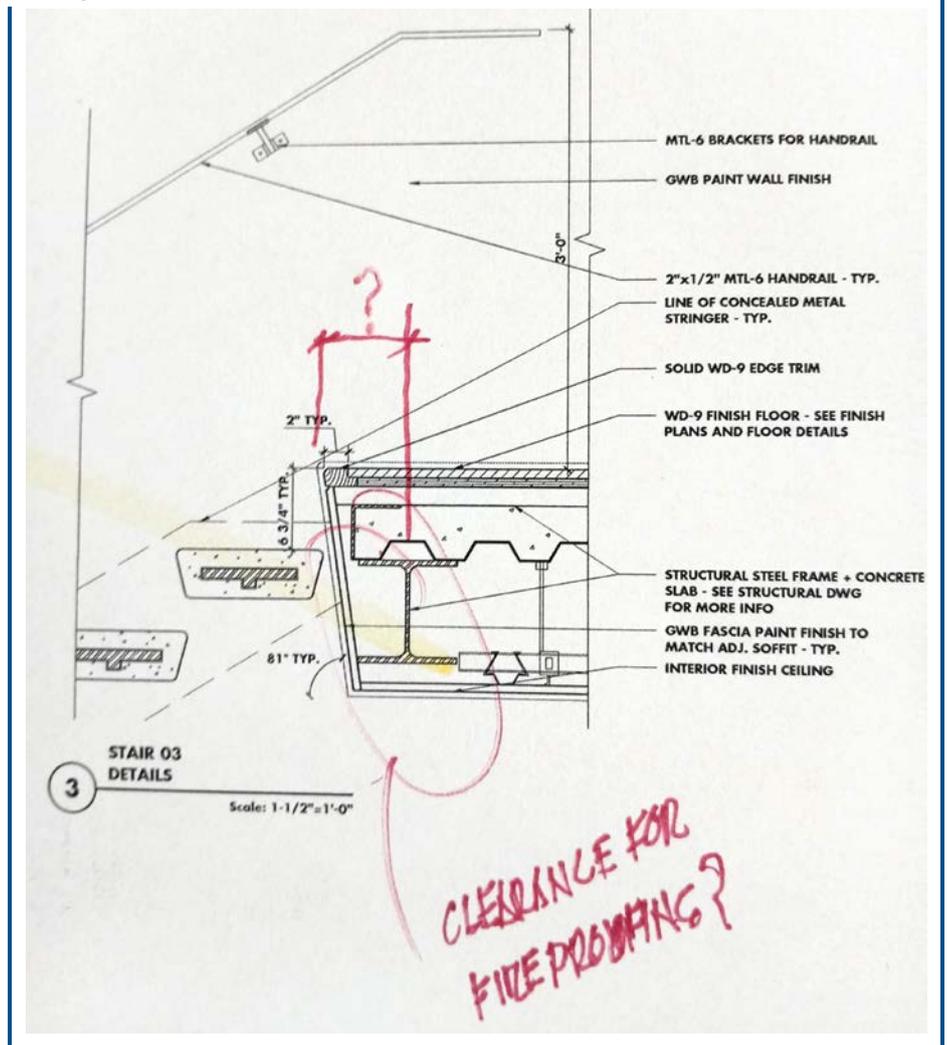
These are just a partial list of an ongoing dialogue that should be established during the construction document phase to ensure the proper coordination between the architect and the specification writer.

Figures 3 and 4 show the required field adjustments to cover the exposed conduits and the piping in the ceiling. Proper coordination and peer reviews will prevent this from occurring.

Part of the peer review is to identify work to be completed to avoid RFIs or errors.

Some offices have a sheet specifically for general notes to clarify requirements, establish precedence between documents, and reduce conflicts. When these issues are not clearly addressed, they often lead to RFIs during the bidding phase; if unresolved at that stage, they are typically discovered during construction, resulting in additional RFIs, potential change orders, and possible construction delays.

**Figure 5**



Redline annotations on the stair detail call out unresolved clearances and fireproofing conditions that are not fully addressed in the drawings. Reviewing details during the construction document phase helps ensure critical requirements are coordinated and clearly communicated before construction begins.

Some of these notes may also be in specifications. Careful coordination is needed to ensure that the general notes are not repeated in the specification. They should only be indicated in one place to avoid discrepancies.

With the increasing number of restoration and renovation projects, more projects are being developed by choosing not to use a spec book and opting instead to include “general notes” on the drawings. While this may be acceptable for smaller projects, care should be taken for larger projects. It is important to include at least the following information:

- Quality assurance
- Mock-ups
- Maintenance materials
- ASTM numbers for materials being used
- Checking the moisture content of the existing concrete slabs for new flooring

These are just a few examples. It is essential to conduct a comprehensive review of the project materials to effectively prevent any potential RFIs or change orders.

### Post-construction lessons learned

Once the project has ended, it does not mean there are no opportunities to review and improve what transpired during construction. An ongoing list should be compiled during a progress field meeting by the field representative (if there is one) or the project manager. This list should identify items that may have been problematic or could be improved upon in future projects. It should contain comments on the drawings, specifications and any acceptable recommendations made by the contractors. This list is intended to facilitate a learning process aimed at enhancing the quality of the documents, as there will always be RFIs and change orders. The intent is to keep them to a minimum, improve document quality, and avoid repeating the same issues on other projects.

Share the list with the project team members and any other personnel who may benefit from these lessons learned.

#### *Partial list of lessons learned*

1. Review with the electrical designer the electrical room equipment layouts based on the exact size of the equipment. The code requires specific clearances in front of switchgear.

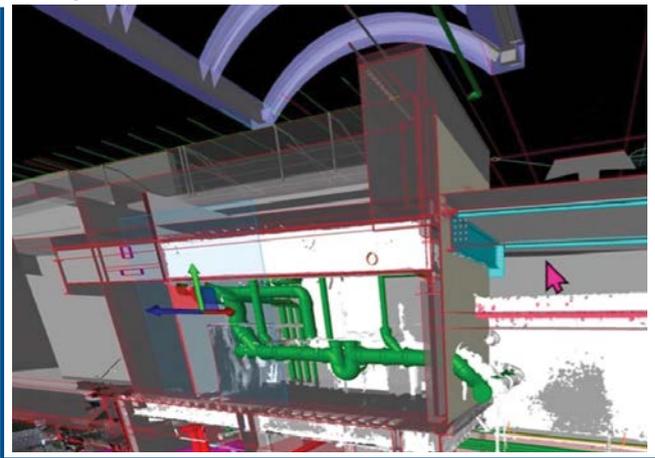
- This is particularly important with respect to the roof ladder and the locations of the structural columns.
- Carefully review with the owner plumbing fixture mounting features relative to security issues and the possibility of hiding contraband.
  - Confirm with the owner the rooms or areas that require security-grade return and supply registers. These must be coordinated with the mechanical engineers.
  - All security fire-rated doors must have detention fire-rated glass.
  - Check to make sure the drawings describe all the required housekeeping concrete pads for the mechanical and electrical equipment.
  - Carefully review with the food service consultant the need for slab depressions to accommodate insulated floors, floor trough drains, and quarry tile floors in the kitchen areas. Pass this along to the structural engineer to include on the foundation plans. Also indicate curbs and reinforcing as required around the food waste pulping system.
  - Anywhere there are suspended acoustic ceilings below sound-insulated drywall ceilings, special care must be taken to ensure mechanical systems will fit.
  - All exposed steel embeds in concrete tilt panels on the exterior should be galvanized.

This list was for a correctional facility. Note: the list includes different trades and should be distributed to all the consultants.

## Conclusion

From the first line on paper or an image on a computer to the completion of the building, the amount of work required to bring a vision to reality can be overwhelming. The

**Figure 6**



A coordinated BIM model reveals clashes between structural elements, architectural assemblies, and MEP systems that are difficult to detect in two-dimensional drawings alone. Using 3D modeling as part of the coordination process allows teams to identify and resolve these conflicts early, reducing requests for information (RFIs) and field changes during construction.

PHOTO BY JOHN LOZA

success or failure of the project rides on one of the most important factors: coordination. Use tools available, such as AIA documents and BIM, which enable 3D modeling and provide an effective way to coordinate and early detect potential problems.

While there is no such thing as a perfect project, these tools are an effective way to reduce potential problems, thus providing a more comprehensive set of documents. The intent is to be proactive and not reactive.

## REFERENCES

- For more information on contractors' change orders, see "Contractor's Guide to Change Orders" by Andrew M. Civitello.

## additional information

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### Key Takeaways

Effective coordination during the Design Development (DD) and Construction Document (CD) phases is critical to reducing RFIs, change orders, and construction delays. Ongoing peer reviews, disciplined document organization, and clear communication

between architects, engineers, and spec writers help eliminate discrepancies before bidding. Proactive coordination strengthens document quality, protects project budgets, and supports smoother construction outcomes.

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## A Bird's Eye View of Building Facades

In urban areas, building facades can sometimes be taken over by birds and other wildlife. Birds roosting on facades should be discouraged due to health risks from droppings and the staining and deterioration they can cause.

Various bird-deterrence strategies are available, each with advantages and limitations that can lead to failure. Chemical deterrents create surface irritants but may stain materials and can become very difficult to remove when they degrade over time. Mastic-type deterrent products should be avoided, as birds can become trapped in these materials.

Acoustic systems use ultrasonic or audible sound and require an electrical power source. Coverage requirements can make configuration challenging when the entire facade of a large building needs protection, and audible deterrents may also be disturbing to people.

Vertical spikes or wires interfere with birds' ability to land on horizontal surfaces but require periodic cleaning, as accumulated debris can create inviting perches. Vertical spike systems may also provide an armature for some birds to build nests. Horizontal wire systems can be placed at façade edges, though some birds may simply step over them.

Copper or galvanized wire mesh has been used as a deterrent, either by design or as a maintenance response. While still common on mechanical louvers, it is rarely used on architectural facades. A common present-day system uses dark plastic netting, pulled taut and secured at its perimeter with stainless steel cables and hardware. Its very fine strands are visually unobtrusive (Figure 1), though effective performance depends on thoughtful installation and ongoing maintenance.

Since bird netting has a shorter service life than most facade materials, fastening hardware should be installed at joints or other easily repairable locations. It is rarely necessary to cover all horizontal ledges; blocking access to primary roosting areas is usually sufficient. On a recent project, older netting covered most of a historic masonry facade, including narrow rusticated ledges. The system was too extensive to monitor effectively, and small tears allowed wildlife access to the ledges behind the netting, creating more desirable nesting areas than would have existed without netting (Figure 2).

Selection and implementation of a bird deterrent system should consider the surface configuration, facade materials, and bird species, as perching and nesting habits vary. A mock-up of the preferred system before full implementation helps evaluate constructability and visual impact. Deterrents

 **Figure 1**



The plastic netting at the large belfry openings of this church steeple is nearly invisible when viewed from grade.

 **Figure 2**



Damaged netting on this building facade provided inadvertent support birds and other wildlife to build nests on rusticated joints.

also become part of routine facade maintenance, including inspection for gaps or displacement, debris removal, replacement of damaged components, and modifications in response to changing wildlife behavior. Even with these requirements, maintaining a targeted deterrent typically costs less than repeated facade cleaning. 



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