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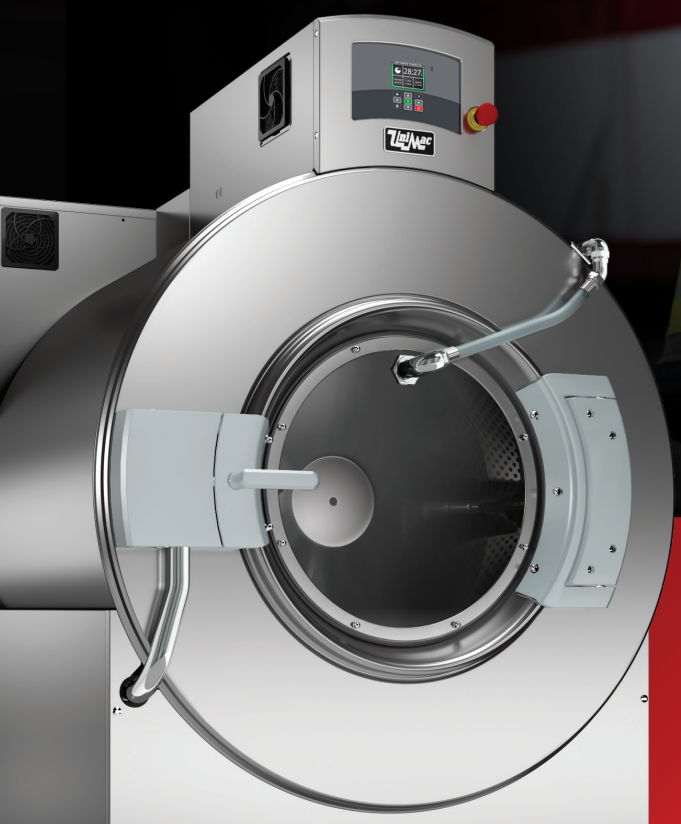

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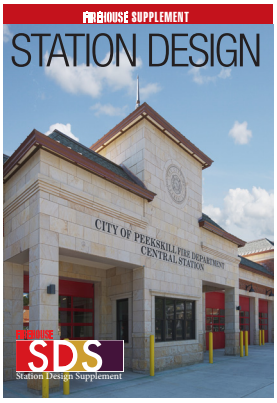


**On the Cover**
**Mitchell Associates Architects, PLLC, designed Peekskill Fire Headquarters. The 30,788-square-foot building serves the combination department in Peekskill, NY.**
*Photo by Bob Mitchell*

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# PROS & CONS of Shared Facilities


**By Craig Carter, AIA, and Michael Healy, AIA**

## The Fridley, MN, Civic Campus showcases the opportunities and challenges that are presented in the design and construction of a mixed-use facility.

Throughout North America, there has been a noticeable trend toward co-locating fire stations, police stations and other government buildings. The typical arguments that are made in favor of this strategy include short- and long-term cost savings and opportunities for operational synergy.

Additionally, an increasing number of facilities require replacement, and some communities don't have the land available to build separately.

The fear of co-location is driven by examples where the fire department or police department relinquished overall control of the project and was handed a building that didn't meet its needs—or even was unsafe. All of these arguments are valid.

The recently built Fridley, MN, Civic Campus is a good example of a shared facility that maximizes shared area while respecting the operational requirements of each department. The project was completed in late 2018. It combines a 24,800-square-foot, six-bay volunteer (transitioning toward full-time) fire station; a 46,200-square-foot police station (including squad garage) that serves 48 sworn officers; city administration space that houses the council chambers; the city manager's office; the departments of finance, parks and recreation, information technology, engineering and community development; and a community room. Across the shared parking area is a stand-alone, 84,300-square-foot public works facility. Co-locating the facilities allowed for the creation of an outdoor water feature, which achieves the required stormwater treatment. Community recreational space includes an amphitheater, a plaza for outdoor events and walking paths. The total project encompasses 14.6 acres and 185,700 building square feet and cost $44.5 million to construct.


**The Fridley, MN, Civic Campus, which was completed in late 2018 and cost $44.5 million to construct, combines a volunteer fire station, a police station, city administration, the city manager's office and several other community departments.** *Photos by Steve Silverman*

## Economies of scale

Large projects attract more competitive bids, because contractors and suppliers refine pricing based on larger quantities. This can result in an overall cost savings per square foot. However, price isn't the only important factor in selecting a contractor. Projects of similar scale to the Fridley Civic Campus frequently have multiple phases, a blend of structural systems, extremely complex building systems and more construction workers on site than a single site superintendent can oversee. Therefore, it's important to team with a contractor or construction manager who has experience managing larger projects and has procedures developed for projects of this scale.

Economies of scale affect design fees, too, but a more important factor is the design team's experience and capacity. When selecting an architect, it's essential to verify that the design team has successful experience with projects of scale and complexity. A project that has multiple stakeholders requires a large team of dedicated architects, engineers and consultants. The architect should have specific experience with every component of your project. Fire, police, city hall and public works facilities each have specific operational requirements that the design team needs to understand and plan for.

When designing the Fridley Civic Campus, the lead architectural firm, BKV Group, teamed with Oertel Architects for its extensive experience with public works facilities.

Although mixed-use facilities might have access to funding from multiple budgets and more sources of grant funding, they also come with large-scale price tags, and this rightly attracts increased attention from the general public. Be prepared to discuss the rationale for the project along with the financing strategy, complete with detailed information on the tax impact to the citizens. Fridley was proactive and involved the public in brainstorming meetings for more than a year before hiring the design team.

## Site design challenges

Although some communities co-locate facilities because of a lack of empty parcels for standalone buildings, others are prevented from co-locating facilities, because the sites that are available aren't large enough or don't meet the geographic needs of each department. Site feasibility is the first obstacle to tackle with your design team before committing to a shared facility.

Fridley was able to take advantage of a large parcel to plan not only their new Civic Campus but also a new neighborhood, including single-family and multifamily developments. That said, there was only one spot within the larger neighborhood that worked for the facility and that allowed appropriate emergency response.

A larger building footprint results in more challenges. At Fridley, a portion of the site has a high water table, which forced


**The design team estimated a savings of more than $700,000 due to shared spaces, one of which included this large training room that serves multiple departments.**

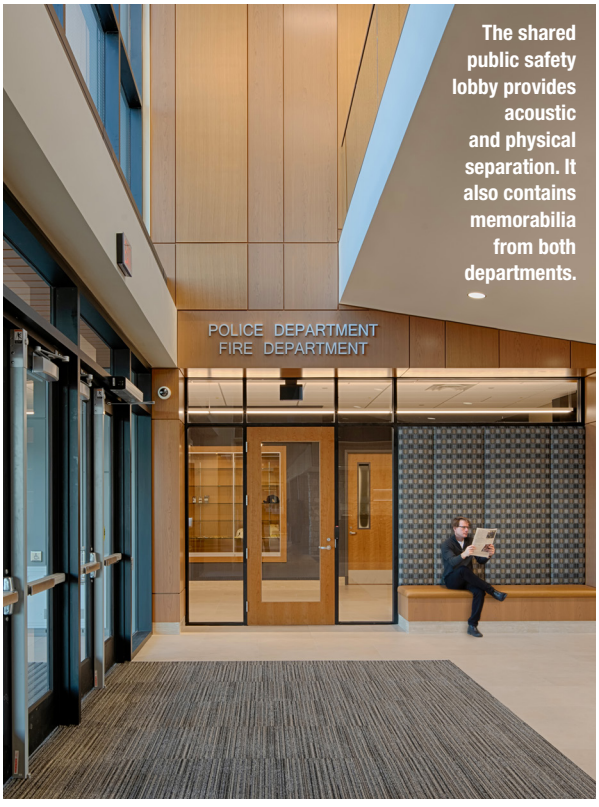
The first floor elevation needed to be raised so that the lower-level squad garage would be above the water table.

the first floor elevation to be raised 36 inches, so the lower-level squad garage would be above the water table. The apparatus bays couldn't be raised because of the existing curb elevation. So, a challenge was presented: How to navigate the different floor elevations? The solution: A small stair between the fire administration offices and the bay floor. However, this level change creates a certain amount of risk during response, and it wouldn't have been necessary with a standalone fire station on this site.

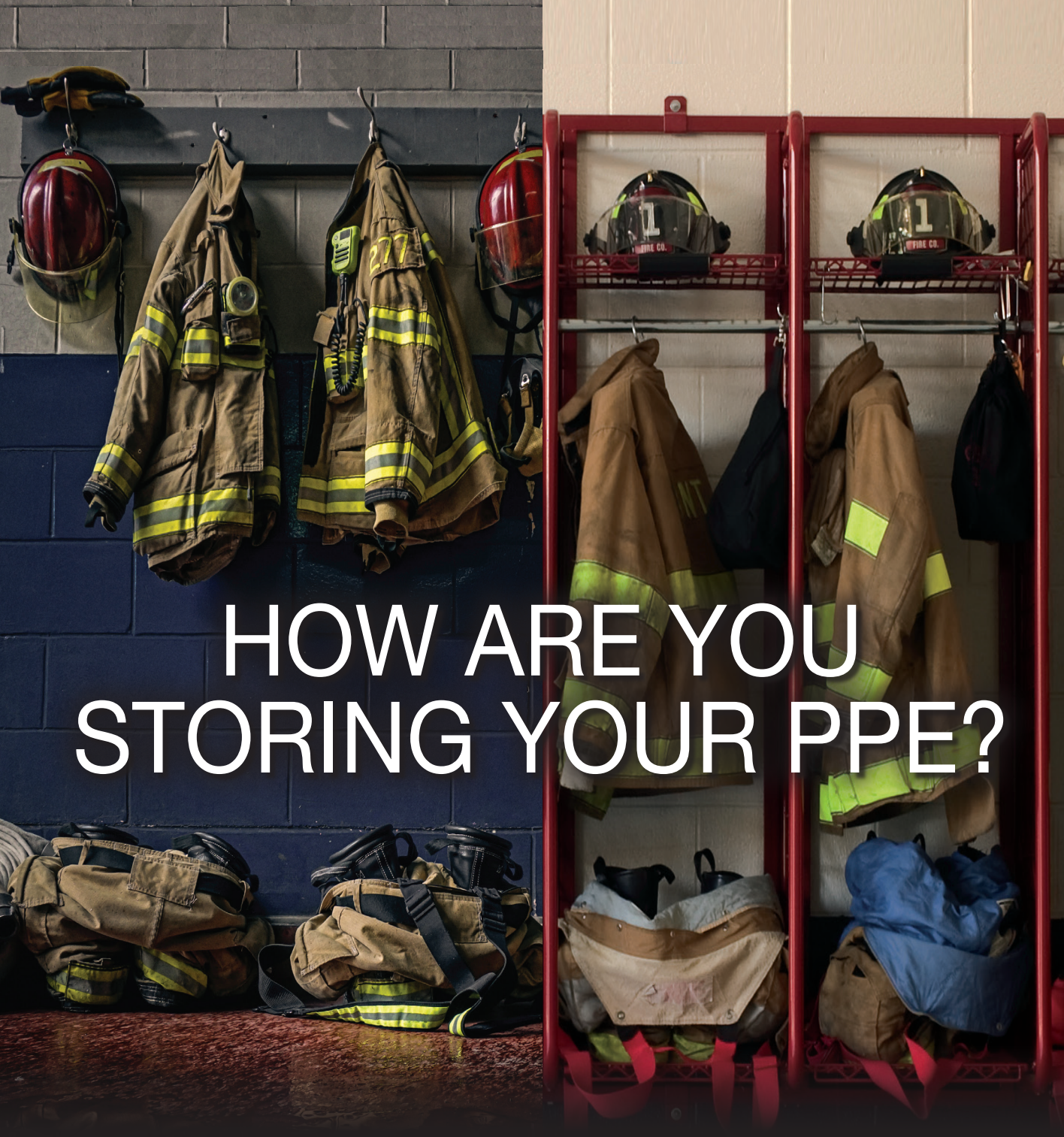
One of the more complicated challenges of a mixed-use facility is organizing vehicular circulation for efficient operation and safety. Public works trucks, fire apparatus and police squads require covered storage, and their movements need to be kept separate from staff and public vehicles for safety and freedom of response. For Fridley, circulation for city vehicles was separated from public and staff parking areas by providing strategic, direct access points into the site to meet each department's operational needs. Public parking to accommodate large events was designed as a pedestrian-friendly plaza and functions as outdoor amenity space most of the year.

## Shared spaces

Co-located facilities tend to be smaller and, thus, more efficient than separate facilities, because departments can share a variety of spaces and systems. When each square foot of building costs multiple hundreds of dollars, savings can add up quickly. Support spaces, such as mechanical rooms and sprinkler rooms, can serve the entire building. Amenity spaces, including physical conditioning rooms and break rooms, also can be shared across departments if they're appropriately sized for the number of users that's expected. The design team estimated a savings of more than $700,000 due to shared spaces.




The shared public safety lobby provides acoustic and physical separation. It also contains memorabilia from both departments.



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**In addition to sharing a reception and waiting area, the fire and police departments share administrative restrooms and two small meeting rooms.**

Sometimes, core function spaces also can be shared. Fridley's fire and police share a reception/waiting area, administrative restrooms and two small meeting rooms, which the police department uses for soft interviews and the firefighters use as a place to confidentially take blood-pressure readings or to assess the symptoms of walk-in patients. When considering the appropriateness of a space for sharing, consider the ways that the departments will make use of the space and the anticipated schedule.

The large training room that's in the Civic Campus most often is used by the fire academy, but the flexibility of the space and the adjacency to other departments allow the room to be used by the police department and other city departments regularly.

Sharing spaces blends department boundaries, and that can cause concerns for security. Even if everyone in the building is on the same team, it isn't recommended to give everyone access to the police armory, for instance. These concerns can be remedied with electronic access control and by designing a shared facility that clearly defines shared circulation space versus operational space for each department.

For the shared facility in Fridley, the police and fire administration areas are separated by a secure hallway that connects to the shared public safety lobby. Staff safety has become an increasing concern in all civic buildings. Police stations typically have a bullet-resistant window to protect staff; however, city hall buildings try to project a welcoming and transparent environment. The shared public safety lobby that's located off of the main city hall lobby provides acoustic and physical separation, for instances in which an unhappy citizen speaks to a police officer. Although the lobby is staffed by the police department, the fire department has direct access to the space to meet visitors, and it contains memorabilia from both departments.

## Operational benefits

The private sector has been touting the benefits of spontaneous collaboration for years as a reason for locating everybody under one roof. The need for distribution of fire stations and the need for security within police stations has delayed that trend for the public sector, but Fridley was intrigued by the concept and toured several local corporations to explore the latest trends in office design. This manifested itself in smaller personal workstations and informal group meeting spaces throughout the facility. The fire service held informal meetings around the kitchen table for years, but sharing space with the police department builds relationships that can be critical to performance in a major event. For instance, the large classroom and the hands-on training mezzanine that includes a reconfigurable system of rooms provide excellent space for the police and fire departments to train on joint maneuvers.

An underappreciated opportunity for operational savings is access to the heating, ventilation and air conditioning (HVAC) systems that are available for large buildings. A small fire station has limited ways to provide heating and cooling. Co-locating with other departments opens up a larger playbook.

At Fridley Civic Center, a lifecycle assessment showed that the scale of the project made a boiler system cost effective. This allowed radiant floors in the apparatus bays without a large upfront price tag.

Even cleaning and maintenance saves money in a combined facility. Minimizing travel time between buildings, reducing the number of floor buffers, requiring fewer dumpster pulls and stocking fewer consumables that can be used for the many bathrooms are just some of the long-term savings that a joint facility enables.

## Competing priorities

One of the most important challenges in a shared facility is making sure that the result works for everyone, and nobody's core operational needs are compromised. This takes strong


**The police department required indoor squad parking, but the site couldn't support additional building area above-ground, which forced the squad garage to be on the lower level.**

**Every department had both wants and needs in the planning of the Civic Center. The fire department, for example, required a hands-on training space for the fire academy.**

leadership from the design team as well as from the owner. Working to a project budget is largely about compromise, and when difficult decisions need to be made, it's easy to advise cutting someone else's space. To avoid this, the design team conducted detailed meetings with each department individually, then brought larger issues back to the full owner team. Each department had to be flexible in its expectations.

Part of the success for Fridley was that the owner team appointed a moderator to attend all of the meetings and guide the overall process, which ensured decision-making was fair across the board.

Each department had critical needs and strong opinions about the layout of their spaces, but not all could be met. Understanding the difference between a need and an opinion requires experience with the project type and a true understanding of the department policies and procedures. For the fire department, response access to the main roads gave the apparatus bays first priority of placement on the site. Back-in bays were a compromise that ultimately wasn't needed with the final design. The fire department's need for classroom and hands-on training space for the fire academy was another critical feature. A compromise due to site and building constraints was placing the living and sleeping spaces on the second floor. Of course, a multilevel facility can have an effect on response times, but that was mitigated through a fire pole and multiple stairwells.

The police department's need for indoor squad parking influenced the building layout, too. The site couldn't support additional building area above-ground, which forced the squad garage to be on the lower level. This resulted in a single point of egress for squad cars, so the design team specified a four-fold garage door for increased reliability.


**The Fridley Civic Campus included a 24,800-square-foot, six-bay fire station that has radiant floor heating in the apparatus bays. A lifecycle assessment showed that a boiler system was cost-effective.**

Both departments required access to the public safety lobby. To achieve this, both the police and fire departments compromised. The police accepted a small separation between the administration staff and other divisions, and the fire department accepted a portion of the office spaces having windows into the apparatus bays instead of to the exterior. Although the compromises represent a break from the ideal scenario, neither had significant impact on operations, and each department was involved fully in the planning and decision-making throughout the design process.

For Fridley, the combined facility has been very successful. The project was strongly supported by the community and was accomplished within budget. The overwhelmingly positive reaction from staff is the true mark of success.

When clients are willing to think outside of the box, and when a thorough design process that identifies opportunities and finds solutions to the challenges is used, co-located facilities can be just as successful. ■

### ABOUT THE AUTHORS

**CRAIG CARTER,** AIA, is an associate partner with BKV Group, which is a full-service design firm that has offices across the country. He is a nationally recognized fire station design expert who has helped drive the industry forward with his advocacy and educational outreach. His projects have been recognized by the *Firehouse* Station Design Awards and the FIERO Fire Station Awards for their beauty and functionality. He speaks nationally and authors articles frequently. Carter is passionate about fire station design and providing excellent buildings that support firefighters in their service to the public.

**MICHAEL HEALY,** AIA, is a senior project architect for BKV Group and has more than 10 years of experience on a variety of projects, including police and fire facilities. Healy has a thorough understanding of the operational needs, workflows and spatial requirements for law enforcement facilities, which he shares with clients nationwide as part of BKV Group's team of experts. Under his leadership, the act of building a public safety facility can be one of symbolic, cultural and environmental significance for the community.

# Air Quality in Your Fire


**By Dennis A. Ross, AIA, and David J. Pacheco, AIA**

**The Cortez, CO, Fire Department utilizes a vehicle exhaust (VEX) removal system.**
*Photo by Marona Photography*

Design teams can manage the quality, treatment and movement of air to further the health and safety of responders.

The quality and cleanliness of the air that we breathe shouldn't have to be a concern, given manufacturing, technological and scientific achievements. However, it's a very big concern.

Much research and information has been gathered and studied about air quality in the micro-climate of the fire station since the United States passed the Clean Air Act in 1970 and created the Environmental Protection Agency (EPA) to enforce it. Additionally, research into the health of first responders, their protection from carcinogens and cross-contamination, and cancer among them has led the way for emergency response architects and engineers to completely rethink how stations are designed. This rethinking has fundamentally changed decades of accepted practice.

For example, in 2020, the NFPA formed the Technical Committee on Emergency Responders Occupational Health to draft new procedures for firefighters (as well as for police officers and EMS first responders) and to include station design layout among the organization's work. The NFPA considers these procedures to be so important that they asked the committee to have a draft by year's end.

## Where do we start?

Most new or seriously renovated fire stations can be divided into three zones:

**Hot zone:** The apparatus bays and their support areas, such as a work room, bay storage and PPE storage;

**Cold zone:** The living/administration areas; and

**Transition zone:** A relatively new area concept that's designed to address the movement between the hot zone and the cold zone.

# Station

The concept of transition zones is most in flux regarding what they are, what they should be, how they are designed and how they integrate into standard operating procedures (SOPs).

In the most general terms, cold zones have a greater treated air flow and, therefore, greater air pressure than the hot zones have. This air treatment keeps possible contaminants from emanating into the air through off-gassing from apparatus, equipment, tools or PPE and then flowing into the living side of the station. A cost-effective method to help safeguard this pressurized flow of air is to make sure that doors that are between hot and cold zones are fully weather-stripped and have a threshold, a door sweep and an automatic closer.

When responders move from the cold zone to the hot zone to answer a call, the clean and treated air will move with them. When responders return from a call, they will be traveling against the current of clean air into the cold zone, with a flow of treated air pushing contaminants to be exhausted into the hot zone.

## Ventilation and filtration

The National Institute for Occupational Safety and Health defines diesel fumes as a carcinogen. It is vitally important to control or mitigate the negative effects on responders of diesel exhaust that's generated by apparatus. There are many types of vehicle exhaust (VEX) removal systems, and each has its pros and cons in regard to how exhaust is captured, treated or filtered. The important thing for responder health is for designers and owners to utilize one or more of these systems in the bays and put SOPs into place to make sure that the systems are used. There are no rules or determinations for gasoline fumes tht are emitted by tools or vehicles, but there is every reason to believe that research will be conducted and that these fumes—and exposure to them—

**It is recommended to store PPE in separate rooms, with air movement for drying, exhaust systems, HEPA filters, overhead fans, and other room specialties to control cross-contamination and off-gassing from exposure.**
*Photo by David Miller Photography*

also will need to be mitigated.

PPE storage is an area that's in transition for designers. Current thinking has PPE confined to separate rooms, with air movement for drying, exhaust systems, HEPA filters, overhead fans, and other room specialties to control cross-contamination and off-gassing from exposure during events and to allow proper drying and storage. With the advent of "clean cab" scenarios, more and more departments are utilizing gross or specialized decontamination at the event. It's vitally important to responders' health that when they enter the apparatus cab they are clean, or as clean as can be. A new protocol is to bag PPE at the event, send it for proper cleaning and, hopefully, have a second set of clean gear back at the fire station ready for the next event.

The PPE room is being treated more as a transition zone than a hot zone. Our professional design advice is to include all of the systems that are outlined above in case they're needed.

**Fitness rooms should have dedicated HVAC systems with heat recovery as well as adequate fresh-air supply and exhaust to control odor and to maintain a healthy, comfortable environment.** *Photo by David Miller Photography*

We shouldn't overlook ventilation and filtration systems in the hot zone areas. Even with VEX systems, vehicles, hose, equipment and even cleaned PPE still can emit harmful contaminants. Ventilation or 24/7 filtration systems are an advisable option to consider. Advanced systems can incorporate indoor air quality (IAQ) sensors that automatically activate the system when air quality drops below acceptable levels. This approach, which might result in higher initial cost, is a more sustainable approach than "always-on" systems.

## Evaluate cold zones separately

On the cold zone side of the station, building and mechanical codes most often will rule the day. Many of these areas are defined as "habitable" space and, therefore, require minimum standards for introduction of fresh air, air changes and exhaust requirements. The mechanical engineer

who works with the architect will suggest various types of heating, ventilating and air conditioning (HVAC) systems. Like all systems, each will have its pros, cons, longevity, complexity, controls and, of course, initial budget and lifecycle costs.

Unintended consequences of new code requirements created tighter building envelopes that require careful consideration of ventilation and exhaust of contaminants. The EPA notes, "Much of the building fabric, furnishings and equipment, its people and their activities produce pollution." The nature of firefighting and emergency response might increase this pollution load.

Various portions of the station should be evaluated separately. For example, if the station design includes individual bunk rooms, consideration should be given to individual controls for each room. Although this might be more expensive than one set of controls for a bank of bunk rooms, the individual comfort and well-being might be worth considering. In a building that has a shelf life of 50–75 years, the HVAC system, its controls, and all it offers toward responder comfort and health should be a decision that's carefully considered. It's unfortunate that in a world of budget realities, proper HVAC systems often suffer from value-engineering cuts. It's the responsibility of qualified station designers to convey the pros, cons, and consequences of these decisions and how they affect the end users.

In some stations that have a training room or community room that might not be used regularly, some simple, cost-effective methods can be utilized to control air movement and minimize energy costs. For example, a carbon monoxide (CO) sensor in the return air duct can keep the system from constantly cycling on.

Many new and existing stations have fitness rooms, too. Whenever possible, treat fitness rooms via dedicated HVAC systems that have heat recovery. At the very least, make sure that there is adequate fresh-air supply and exhaust to control odor and to maintain a healthy, comfortable environment. As with train-

**The Norwalk, CT, Fire Department has an exhaust hood with an Ansul suppression system above the stove.** *Photo by David Miller Photography*

ing rooms, the use of CO sensors or other IAQ systems can help to save energy costs when the room isn't in use.

The kitchen also is an area of great concern. It produces cooking odors. It's one of the main gathering spaces in the station. It often is a very busy place. Although some states and jurisdictions consider a fire station kitchen a commercial kitchen, many don't. A commercial designation requires an exhaust hood that has an Ansul suppression system above the stove, fryer or burners. (The suppression system doesn't apply to this discussion, but it does affect the budget.)

A true kitchen exhaust hood (not recirculating) involves large volumes of makeup and exhaust air. The trick is to be able to supply makeup air as close to or within the hood itself, so the hood's drawing of heated or conditioned air from the kitchen is minimized. A heat recovery system is advisable in colder climates. Because the kitchen often is open to dining and day rooms, moving large volumes of air can cause discomfort in all three rooms and cost the owner in energy usage.

In addition to the hood, general cooking odors in the kitchen need to be controlled by the building's HVAC system. If your kitchen has a patio that has a grill, which might be utilized year-round, general heat and air conditioning should be specified to manage the outside air flow from persistent use of the exterior door when using the grill.

Bathrooms, too, should be designed to include adequate ventilation, exhaust, negative air pressure and heat recovery.

## What you can do today

Minor, but important, rooms also must be considered. For example, the janitor's closet is No. 1 on the EPA's list of indoor contaminant sources. An exhaust fan that runs constantly should be considered to manage odors and contaminants from cleaning products. During the winter in many locales, a heat recovery system in the ductwork can save on the energy cost of exhausting treated, heated air.

Instead of a room that's dedicated

to storing volatiles, such as oil, paint and various fluids, consider a ventilated storage cabinet that's made specifically to store volatiles. These are rated for this type of storage and can save the cost to supply HVAC and exhaust to an entire room.

Cost, value and HVAC systems always have been hot topics in station design, but with the influx of new research, SOPs and the focus on responder well-being, the quality and movement of air in the station will continue to take on more importance. What can you do today to protect your responders? Get an IAQ test, perform an airflow pattern test, introduce a transition zone(s), change filters and maintain equipment and observe VEX protocols. Then, breathe easier. ■

### ABOUT THE AUTHORS

**DENNIS A. ROSS**, AIA, is the director of Emergency Services Market at H2M architects + engineers. He is National Council of Architectural Registration Board (NCARB)-certified. Ross is a member of the American Institute of Architects, the NFPA and the International Code Council. He is licensed in 14 states and is an honorary member of the Kingston, NY, Fire Department. His expertise in public forums, project management, land use, budgeting and construction and his focus on solutions to difficult problems has enabled Ross to knowledgeably write and speak on a variety of fire station design issues. He co-authored "Chief Fire Officer's Desk Reference and Fire Station: Architectural Insight to Planning, Design & Construction." Ross is the only architect to attend the NFPA Technical Committee on Emergency Responders Occupational Health.

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# The Living Building Challenge

By Brian Harris, AIA, and Brad Liljequist, LFA

## Public safety facilities push the boundary of design.

Essential facilities have pursued "green" building strategies and certifications for decades. New thinking about how to support the mission of critical facilities through the lens of autonomous operations/resiliency, total cost of ownership, and responder health/wellness has expanded the vision for what an ideal essential facility might look like.

The Living Building Challenge (LBC), which generally is considered the world's most stringent green building standard, might at first glance seem to be far removed from the difficult, daily realities and demands that an essential facility is expected to support. A deeper look, however, suggests that the underlying principles of the LBC contain a practicality and toughness that support the design and development of outstanding, next-generation, 21st century critical facilities.

**In Mosier, OR, a solar array will provide electricity to the fire station portion of a mixed-use facility during the day and send any surplus to the electric grid.**
*Image courtesy of Minarik Architecture*

### What is the Living Building Challenge?

The LBC includes seven topic areas: place, water, energy, health and happiness, materials, equity and beauty.

Projects may certify entirely or partially under the LBC. There also are targeted zero-energy and zero-carbon certifications. The certification requirements can be found at living-future.org/lbc-3_1/certification.

Without doing a deep dive into the LBC certification requirements (and, perhaps, holding your eco-preconceptions at bay), it's helpful to consider some of the underlying philosophy that's behind the LBC.

**Net positive:** Much green and environmental thinking focuses on how to reduce our impact on the environment, as if humanity is fundamentally at odds with the planet. The LBC turns this on its head and pursues a net positive approach through designing and building in a way that leaves the world a better place than we found it and gives more than it takes.

**This project in Mosier, OR, combines a city hall, a fire station and a community center.**
*Image courtesy of Minarik Architecture*

As a result, LBC buildings are deeply efficient and collect the natural assets that are available at each unique site.

**Use natural, simple systems first:** The best LBC buildings often hearken back to the pre-electric, pre-fossil-fuel era. They take advantage of natural heat, daylight, cold and wind to serve the building before they use mechanized systems. This means that many LBC buildings are reasonably habitable without any powered inputs.

**What does good look like?:** This is a common question in the LBC ecosystem. Rather than starting with prescriptive code compliance or detailed certification requirements, agencies and their designers are given aggressive goals, such as net-positive energy and water performance, and are asked to use creativity and community-learning to find solutions.

**Connect with nature:** The highest-performance buildings connect people to nature rather than isolate them from it. The LBC recognizes that people perform best when they are connected to nature through views, fresh air, natural materials and an array of other experiential strategies.

## What is included?

Currently, an ideal next-generation essential facility fully provides the core programmatic functions of emergency services while it supports and protects resources for sustainable operations. It provides seamless service communications as well as the rehabilitation and tools that are necessary to adequately prepare for the next event.

We suggest three additional elements for an expanded vision of a next-generation essential facility: resilient and autonomous operability; restorative environment; and lowest long-term total cost of ownership.

Resilient and autonomous operability speaks to the matter that, if any building should be operable during an emergency, it should be an essential facility, at least partially (think post-severe earthquake, firestorm, hurricane or any circumstance in which power and public services are unavailable for a long period of time).

Related to energy and off-grid operability, the LBC requires net-positive energy performance. For energy, this means that the building actually produces more power than it uses over the course of one year. It also requires a small amount of battery backup storage. However, this typically assumes a building that is tied to the electric grid.

**This 39,500-square-foot police station in Cincinnati achieved LBC Zero Energy Certification via a 20 percent net-positive surplus of 62,000 kwh/year that's provided to the electric grid.**
*Image courtesy of Emersion Design*

A thoughtful and knowledgeable design team can combine LBC net-positive energy requirements and project resiliency goals to build a facility that can operate autonomously from the grid, at least for core functions. To achieve net-positive energy performance, buildings need to radically reduce energy use. This often is done by substantially improving the exterior of the building with better insulation and air sealing. If combined with well-positioned and specified windows and heating base loads, a facility can operate through passive solar and internal heat gains without mechanical heating. An essential facility can continue to operate even when the electrical and natural gas grid is down and when diesel fuel for the generator is unavailable. Designed properly, solar panels can recharge the batteries during the daytime, which allows the facility 24/7 operations.

Similar to energy, the LBC requires net-positive water performance. In part, this means that the facility collects all of the water that it needs through wells or rainwater, with hydraulic balance with the aquifer where available. In practice, this means that LBC projects include a large cistern as well as potable-grade filters. In the face of water-supply disruption (a possible outcome of a major earthquake or extreme drought), such systems could second as an emergency drinking water source for the broader community.

When it comes to a restorative environment for the health and wellness of first responders, essential facilities should be a refuge for firefighters, medics and police officers. First responders must contend with heat stress, toxic exposure, pathogens, and emotional and physical trauma. The stations that serve them should help with their rehabilitation and recovery to maximize mission readiness.

The LBC materials and health requirements substantially align with these goals. The LBC includes what is called the Red List, which prohibits materials that have chemicals that have known health concerns

## Examples in Public Safety

### Mosier Center, Mosier, OR

This project was designed by Minarik Architecture with support from fire station design specialists TCA Architecture + Planning (TCA) and McKinstry. It combines a city hall, a fire station and a community center. It is targeting LBC Zero Energy (ZE) Certification. It will take advantage of the strong westerly breezes for daytime natural ventilation and of the low nighttime temperatures to cool the building, which will be retained by a well-sealed and insulated envelope. The solar array, which is adequate to offset annual energy use, will provide electricity to the station during the day and send any surplus to the electric grid.

### Cincinnati District 3 Station

This 39,500-square-foot police station, which was designed by Emersion Design and CMTA, achieved LBC ZE Certification via a remarkable 20 percent net-positive surplus of 62,000 kwh/year that's provided to the electric grid. The building uses ground-source heat pumps to substantially reduce its heating and cooling load. The 20-year operating expense savings for the $16 million facility (delivered via design/build under its existing budget) was $2.2 million. The operating energy use intensity, excluding solar production, was 26.7 kbtu/sq ft/year, which represents a 66 percent reduction from the 79.4 kbtu/sq ft/year baseline.

### City of Bellevue Fire Station 10, Bellevue, WA

This 25,000-square-foot project is being designed by the City of Bellevue and Bohlin Cywinski Jackson and supported by fire station specialist design partner TCA. The project is tackling the integration of five key project goals: protected, prepared and healthy community; community connection; civic presence; firefighter health and wellness; and sustainable design. The team is evaluating the integration of LBC core metrics with a baseline Leadership in Energy and Environmental Design (LEED) certification and Salmon-Safe Certification. The highly integrated design process is testing performance metrics against natural site amenities, resiliency, firefighter wellness and broader civic goals, which will connect, rather than isolate, the facility and its inhabitants.

from being used in buildings. The Red List includes vinyl and fire retardants, which create highly toxic smoke when they are burned, aligning the LBC twofold with first responders' health. Many Red List-free materials are found on the Declare database at declare.living-future.org.

In conjunction with this is the premise of the Central Valley Fire District in Belgrade, MT, where the decontamination and cleaning process was decoupled entirely in a separate building outside of the core station. A video of their process can be found at glatfelters.wistia.com/medias/0zecb4jd9g.

The LBC also requires projects to connect occupants with nature—through views to the exterior, use of natural materials inside and daylight, among others design practices—to improve the occupants' physical and mental health and to optimize their performance.

An important and reasonable question about the LBC is, "How much does it cost and how is it paid for?" Looking at this question

holistically, including costs that relate to long-term durability/replacement cycle and operating costs, will result in lower net costs to the station operator. Considering that an operating budget often is more difficult to obtain than capital budget, this view of cost is even more compelling.

The LBC/next-generation building does cost more to build, however, these upfront costs are more than recovered through operating savings and the increased durability of the facility. Operating savings can be well-understood and predicted, even to the degree that some energy companies will guarantee energy savings. Designed right, the LBC/next-generation building should be more durable. A better-sealed and insulated exterior requires much more care during construction, resulting in less heat loss and gain, better weatherproofing, and less potential for water intrusion, corrosion and rot. Simpler and higher quality mechanical systems, such as hydronic distribution, have fewer moving parts and have less room for failure.


**Blue Solutions batteries are solvent-, cobalt- and nickel-free and support extreme temperatures without any cooling system.**
*Image courtesy of Blue Solutions*

With an intense focus on community and emergency-responder safety, pushing the boundary of facility design in an integrated and holistic way better informs the design of next-generation facilities. This helps us all to become better ready for the future. ■


**ABOUT THE AUTHORS**

**BRIAN HARRIS,** AIA, is the principal/president of TCA Architecture + Planning Inc., having led in the design of more than 150 fire facilities in 10 states. He won numerous design awards and authored many articles on fire facility planning and design. Harris is a frequent speaker at national fire facility conferences, and his career includes significant firsts in the fire facility design industry. He was the architect of record for the first LEED-certified fire station in the country, the first LEED-certified training facility in the country and the first LEED Platinum net zero energy fire station.

**BRAD LILJEQUIST**, LFA, is the zero energy program manager for McKinstry, where he leads the company's zero energy efforts nationally and managed the zero energy elements for Catalyst, which is a McKinstry developed project that will be the world's largest Zero Energy building when the project receives its certification. Previously, Liljequist directed both the energy and community programs for the International Living Future Institute and developed the first certified multifamily zero energy project to be located in the United States; that projecct is called zHome. He also developed the Issaquah, WA, Fire Station 72, which is the winner of the national ASHRAE Technology award.

# Holistically Healthy Fire Stations

By Paul Erickson, FAIA


**Arlington, VA, County Fire Station 8 incorporates holistically healthy strategies including secluded bunk rooms, natural light and a transition zone with a decontamination room.**
*Images courtesy of LeMay Erickson Willcox Architects*

Design strategies can increase firefighter health and well-being.

Five years ago, cancer in the fire service was treated as something that "just happens." Today, a number of states have presumptive cancer laws, and legislation works its way through other state legislatures to provide benefits to families of firefighters who contracted cancer as the result of duty-related exposures.

Until very recently, the high rates of suicide, depression and post-traumatic stress disorder, or PTSD, in the fire service weren't recognized as interconnected with line-of-duty incidents and exposure to traumatic events.

Now that the physical and behavioral health challenges that are faced by emergency responders are linked to their calling, architects who design fire stations have the responsibility to create firehouses that provide a holistically healthy environment for firefighters and EMS responders. Fire departments and architects now are called to place the crew's health and well-being first in every renovation or new fire station design that they undertake.

## Contain the contaminants

Firefighters are exposed to toxic chemicals and carcinogens that cause cancer on every incident that involves smoke of any kind, whether a dumpster fire, a stove-top fire, a burning vehicle, a garage fire or a major structure fire. Firefighters also are exposed to breathing toxic gases and particulates that are by-products of the apparatus diesel engines that run on scene or back home at the station. Hostile environments that are formed by airborne contaminants are expanded by wind and linger long afterward in cleanup and overhaul environments. At the end of the incident, unless thorough decontamination is practiced on scene, contaminated personnel and clothing, equipment, tools and vehicles bring contaminants back to the station where the crew eats, sleeps and works.

The third floor of the Arlington, VA, County Fire Station 8 offers sweeping views over the roof-tops of the neighborhood and a covered balcony for outdoor dining.

To combat this, hot zone design strategies, which first were proposed in 2014, have been adopted widely by architects and fire departments across the nation. The underlying design strategy categorizes and organizes rooms and spaces according to their level of exposure to contaminants. Hot zones (red) house any equipment that's directly involved in emergency response and represent the level of highest risk or exposure in the station. Safe/cold zones (green) are reserved for all work and living spaces that typically are occupied by the crew. Transition zones (yellow) separate the hot zones from the safe/cold zones with carefully considered storage, cleaning and decontamination facilities, including personal decontamination toilets and showers. (Read more on these spaces at firehouse.com/11588372.)

How and where to clean apparatus remains one of the more challenging aspects of the decontamination process. Wash down of apparatus should occur on scene, if possible. More realistically, wash down of apparatus occurs back at the station, preferably outside of the apparatus bay.

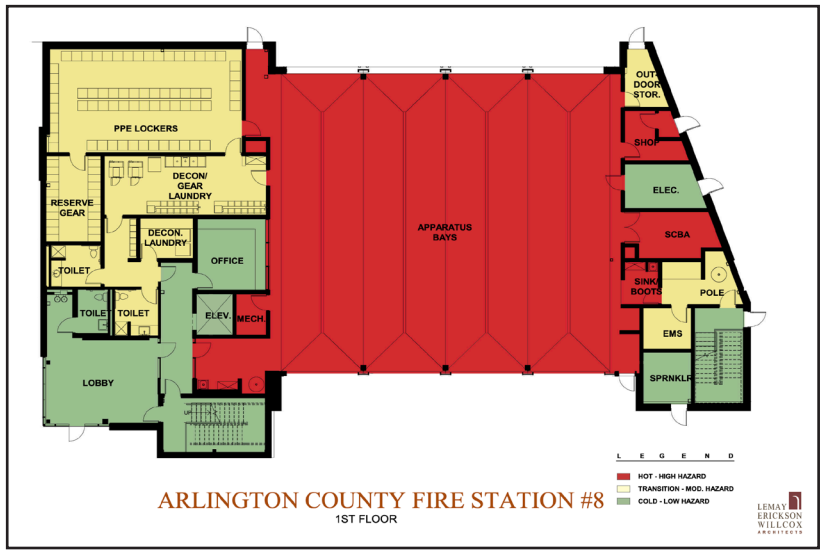
In one example of a successful design, the Salisbury Fire Station for the South Australian Metropolitan Fire Service has drive-through apparatus bays that include an overhanging canopy above the rear apron. This affords an outdoor protected area that has dedicated trench drains in which to wash the apparatus before parking it in the bays.

In another innovative design, the Central Valley Fire District Fire Station 1 in Montana employs a completely separate building for washing apparatus and cleaning gear. Acting somewhat like a commercial drive-through car wash for fire apparatus, the simple, free-standing structure is located alongside the rear apron, so returning apparatus and crews can drive into the one bay structure, wash the apparatus, remove and clean their PPE and then drive the clean vehicle into the main station apparatus bay for ready response.

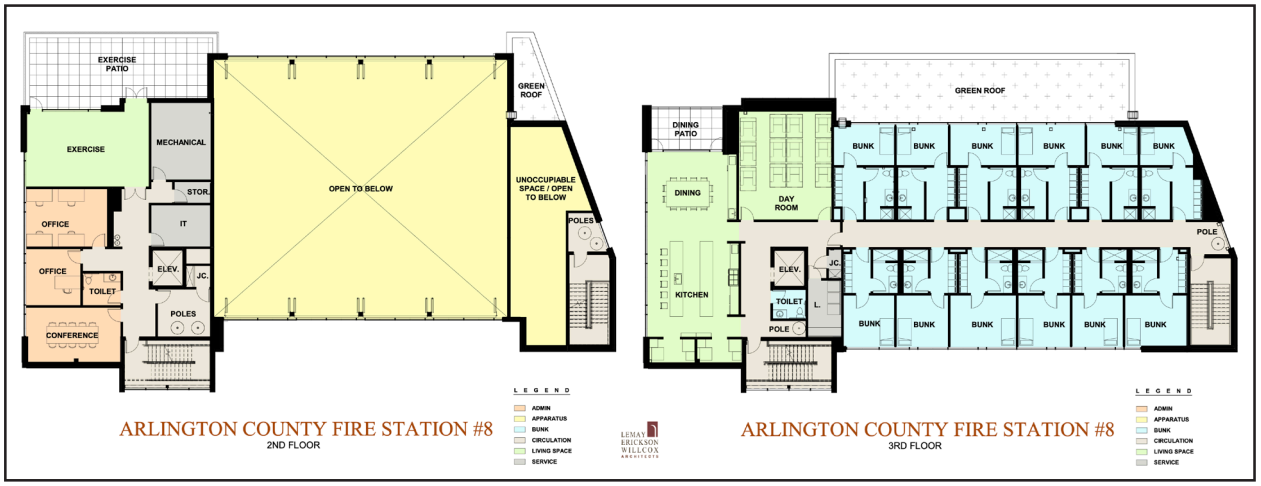
A third approach to apparatus washing is employed at the Beachwood, OH, Fire and Rescue Station 2. A single returning apparatus bay that's located at the rear of the station is approached from an angle on the side of the building. The returning vehicle is washed in a dedicated bay while PPE is cleaned in an adjacent space. Once the apparatus is clean, it is advanced within the building and parked in its first-due response position.

## Improve behavioral health

Design strategies should work to improve the behavioral health of firefighters and other first responders.




The Arlington, VA, County Fire Station 8 first-floor spaces are organized by risk of contaminant exposure into hot, transition and safe/cold zones.




**The second floor is home to a large exercise room while the third floor includes 12 bunk room suites.**

Scientific research over the past 30 years demonstrates that views to the natural world and daylight improve outcomes for medical patients who are recovering from treatment in hospitals and other healthcare facilities. Even in completely interior rooms that lack windows, representations of the natural world can have a significant effect on behavioral health.

In one study that was conducted at a jail intake processing facility, the main wall in a waiting room was painted with a full-height mural of an outdoor nature scene. Workers who were surveyed and studied before and after the mural was painted demonstrated improvements in energy, stamina, decision-making and blood-pressure levels, with reduced levels of stress, anxiety and depression.

Another strategy that's called biophilic design emphasizes the connection between humans and the natural world by intentionally incorporating trees and natural plant material, views to the outdoors and natural building materials into the man-made environment. While embracing biophilic design, modern healthcare architecture also introduces representations of nature into healing environments by using flowing or complex organic forms and patterns in room finishes (think floor tiles, wall coverings, fabrics, upholstery, drapery, etc.) and artwork. The result is a rich, visually interesting environment that has color, depth, daylight and layers of space.

## Promote better sleep

A growing body of scientific research shows how human anatomy is inextricably linked to the natural 24-hour cycle of the day. Many of our body's activities exhibit circadian rhythms that are regulated by our endocrine system, which secretes a variety of hormones throughout a 24-hour cycle. Activities including digestion, wakefulness and sleep are stimulated or suppressed by the release of hormones that are, in turn, triggered by the amount and timing of daylight that enters the human eye. Disruptions to this delicate balance of hormones are created by many of the common experiences that are found in the fire service including sleep disruption, exposure to street and building lights at night during a call, and eating

throughout a 24-hour shift, particularly during nighttime hours.

Sleep disruption is common throughout the emergency response community and manifests itself with both short- and long-term health consequences. According to a study that was reported in the *Journal of Clinical Sleep Medicine* in 2015, 37 percent of firefighters showed signs of a sleep disorder, the majority of whom were undiagnosed and untreated. The study cites increased likelihood of the following conditions for firefighters who had sleep deprivation when compared with the general public: cardiovascular disease (240 percent), diabetes (190 percent) and depression or anxiety disorders (300 percent).

It's clear that optimizing the sleeping environment at the station is essential to firefighter health. Although some fire departments still utilize traditional group bunk rooms that have designated male/female locker and restrooms, the majority of the fire service has moved to

## A CASE STUDY

A current project in Virginia for Arlington County Fire Station 8 incorporates all of the strategies that are discussed in the main article in a holistically healthy, three-story design. It captures hot zone contaminant control, immersive design for behavioral health and design for resiliency in a state-of-the-art building.

The first-floor spaces are organized by risk of contaminant exposure into hot, transition and safe/cold zones. The transition zone has a decontamination room for equipment cleaning as well as personal lockers, private decontamination restrooms with showers and a laundry for contaminated uniforms.

The second floor provides a large exercise room for physical training, which includes expansive windows that overlook an outdoor exercise patio that's available for use by group training classes.

The third floor provides 12 bunk room suites. Each has a secluded bunk room for undisturbed sleep and a private restroom/shower for gender neutrality. A small locker area serves as an antechamber to both the restroom and the bunk room, providing closet support to both spaces while preventing disruption of the night crew that sleeps in the bunk room when a new shift comes on duty.

The third floor also contains the "heart of the building"—a communal kitchen/dining room that has continuous, tall windows that flood the room with natural daylight and offer sweeping views over the rooftops of the neighborhood beyond ... the neighborhood that the station serves. A kitchen counter provides seating for an individual or small group. Nearby, a covered balcony creates a private overlook for outdoor dining, conversation or simple contemplation. In the center of the room is a large dining table.

For those who choose to serve, this space is a home that encourages engagement and connection, both outward with others and inward with self.

private bunk rooms that are supported by single-user, private restrooms. Not only does this approach provide an effective solution for gender-neutral facilities, it also enhances the quality of sleep by limiting disruptions that are caused by the nighttime movements, CPAPs or snoring of others as well as calls that are handled by other members of the crew.

When installed with private bunk rooms, modern alerting systems can be controlled to activate only those bunk rooms that are occupied by sleeping crew members who are required to respond. These alerting systems also ease the shock of sudden calls with "ramped" components that start alarm tones at low volumes that rise slowly to avoid cardiac shock for wakening firefighters. The ramped systems also control the bunk room and response path lighting by slowly raising the light levels and avoiding visual shock and disorientation for groggy responders.

## Build resiliency

Communal and private aspects of crew life intersect with and are shaped by station design. Behavioral health and resiliency can be improved by social engagement and by sharing of communal areas, such as the kitchen/dining room/dayroom. Daylight-filled rooms that have expansive views to nature create an atmosphere that cultivates an esprit de corps by building bonds of trust and friendship with one another. Sharing a meal binds crews together like no other regular experience. According to former Phoenix Fire Chief Alan Brunacini, "Everything important happens around the kitchen table."

Yet, private space is just as important for many in a building in which nearly everything is shared. Private, single-user bunk rooms provide just such a space for someone to escape and work out a recent experience with quiet meditation, call or text chat with a loved one or read a good book.

Creating outdoor spaces for use by firefighters can be surprisingly valuable in processing trauma and building resiliency as well.

Although fire stations used to be designed solely for efficient and rapid delivery of emergency services, architects and fire departments today also use design to respond to the physical, mental and emotional health issues that challenge the lives and well-being of firefighters. ■


### ABOUT THE AUTHOR

**PAUL ERICKSON**, FAIA, is the president of LeMay Erickson Willcox Architects. Throughout his more than 40-year career, Erickson has been recognized consistently as one of the Commonwealth of Virginia's most acclaimed architects. He managed and designed award-winning projects and served the profession as: an active leader of the Virginia and Northern Virginia chapters of the American Institute of Architects (AIA); a juror for prominent design competitions; and a speaker at national conferences. In 2014, the AIA's Northern Virginia chapter presented him with the Award of Honor, which is the chapter's highest award. In 2017, Erickson was elevated by National AIA to Fellowship, which is the organization's highest membership honor.

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