



Wold

FROM RED TO GREEN:
HOW A ZONED APPROACH
TO FIRE STATION DESIGN SUPPORTS
FIREFIGHTER HEALTH AND SAFETY

Fire-fighting safety precautions often focus on the scene of a fire, but minimizing exposure to lingering carcinogens and other contaminants extends well beyond a fire event.

Cancer is an ongoing occupational hazard and concern for fire personnel, with a growing body of research that shows the increased risk for firefighters.

A multi-year study of 30,000 firefighters by the National Institute for Occupational Health and Safety found that firefighters had a 9 percent increase in cancer diagnoses and a 14 percent increase in cancer-related deaths compared to the general U.S. population.¹

Despite improvements in personal protective gear, hazards on the scene are growing more aggressive. Increasing use of synthetic building materials over the past 40 years is one contributing factor to fires that burn hotter and faster, with more toxic smoke.² The often harmful particles from these blazes and smoke can remain on gear, clothes and skin without proper decontamination practices.

“For years, we thought the biggest hazards of firefighting were at the scene of a fire. Now, we’re recognizing how important the fire station’s environment is to our health,” said City of Minnetonka Fire Chief John Vance, who is helping guide the city’s efforts to replace its station from 1975 with a new facility. “That’s why we made decontamination strategies a design requirement for our new station. If we can improve the quality of the station’s environment, that can have a big impact on our department’s health.”

To support firefighter health and safety 24 hours a day, fire departments and city councils are exploring how their fire stations’ architectural designs can reduce the risk of exposure to lingering contaminants in the many hours outside of a fire event.

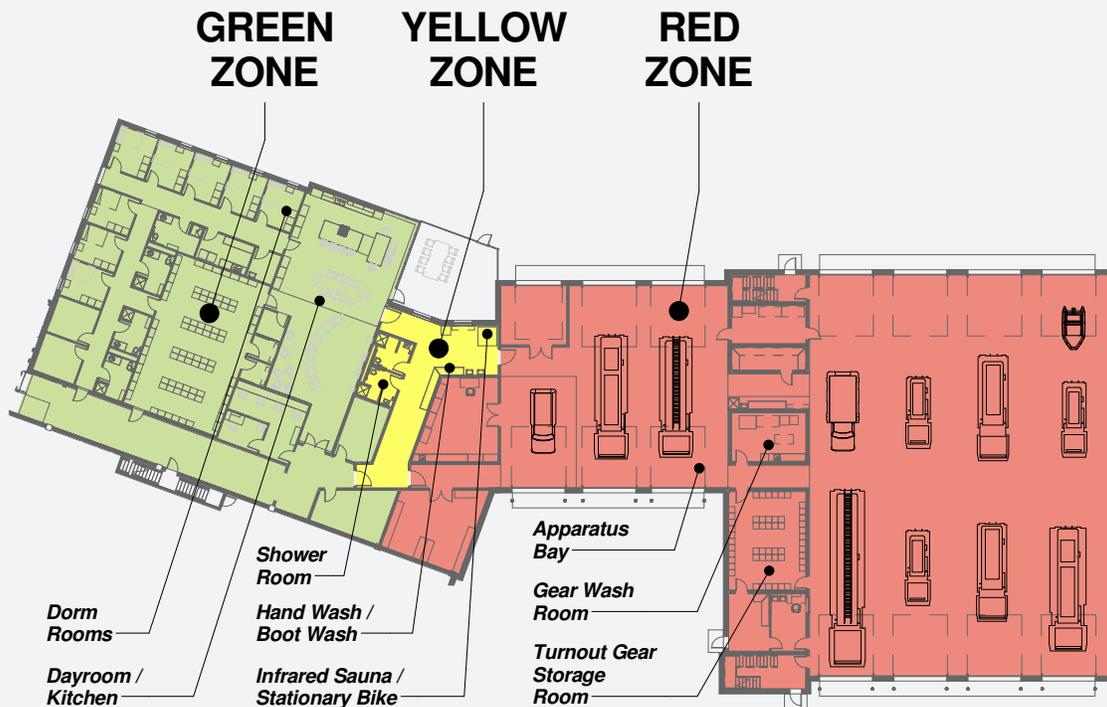
Designating different zones within a fire station is an emerging design method to reinforce and support a department’s decontamination strategies. This approach can reduce the risk of exposure to contaminants and improve firefighter health and safety, without compromising response time.

DEFINING ZONES THROUGHOUT THE FIRE STATION

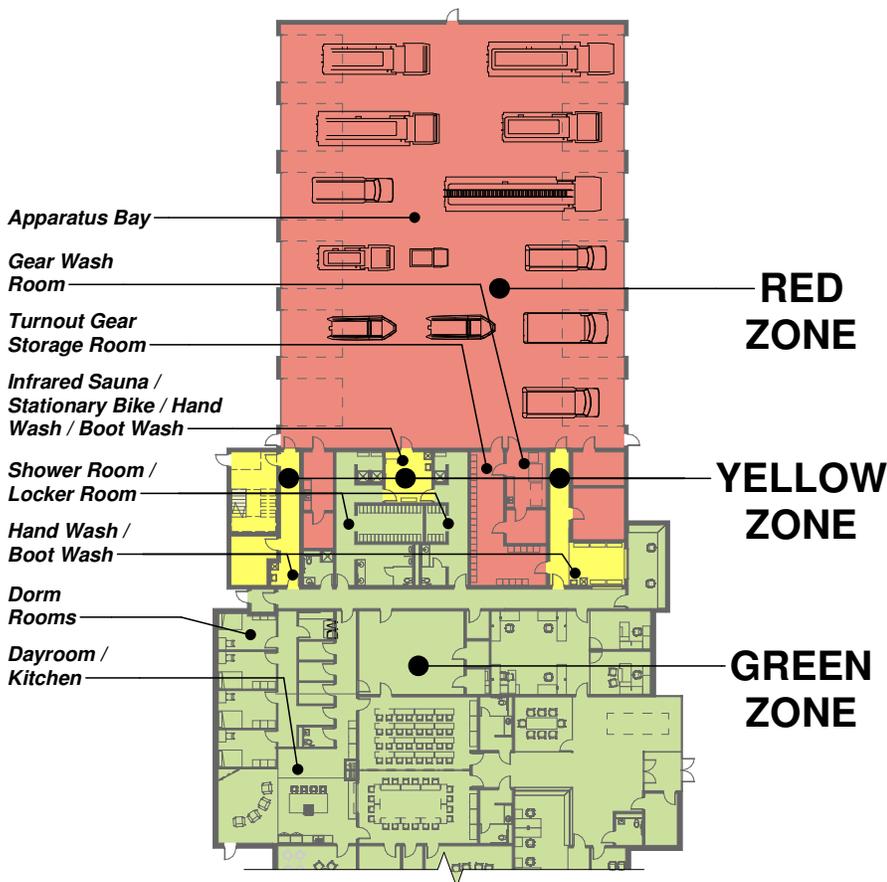
As firefighters move from the apparatus bay into living environments after a call, it’s essential to remove contaminants that originated at the scene of a fire. This is best achieved by moving personnel from zones of higher contamination to zones of low to no contamination.

Red zones, also called hot zones, have the highest level of contaminants. These are the areas firefighters first enter when they arrive at the station after the scene of the fire, and where dirty turnout gear and equipment is washed. Apparatus bays may be considered red zones when trucks first return to the station, before cleaning.

Yellow zones are transition zones that firefighters enter after the red zone. They offer a buffer between red zones and green zones, and a second chance to ensure no contaminated gear enters a green zone. Yellow zones often include showers to remove contaminants from the body. These areas should also contain a hand wash and boot wash stations along the common path of travel between the red and green zones. This helps ensure their use any time someone enters the green zone, regardless of any known exposure to contaminants.



Designating different zones within a fire station is an emerging design method to reinforce and support a department's decontamination strategies. Red zones have the highest levels of contaminants, while green zones have low to no contaminants present.



Green zones have the lowest level of contaminants, and can be free of all contaminants and carcinogens when part of a zoned approach to the station's design. Common green zones include living areas, break rooms, training rooms and administrative offices.

Design features help ensure that each zone remains isolated from the other. This can reduce the risk of exposure to contaminants after a fire, during the significant time firefighters spend at the station over long shifts.

ISOLATING AND REMOVING CONTAMINANTS IN THE APPARATUS BAY

The level of contamination in the apparatus bay can vary widely throughout the day.

The bay is often considered a high-contamination red zone when trucks return from the scene of a fire. The contaminant risk is lowered after the trucks are cleaned. Stopping the spread of contaminants and carcinogens often starts with isolating the bay.

Vehicle wash bays are a primary design feature to reduce on-vehicle contamination when trucks arrive at a station after a fire. Other important considerations are exhaust extraction systems and the heating, ventilation and air conditioning (HVAC) system.

Engines often run as teams prepare to head out on a call. Apparatus bays should include direct-capture systems to eliminate exposure to carbon monoxide fumes from vehicle exhaust. With these systems, a tube or hose connects to a vehicle's exhaust pipe so harmful diesel exhaust does not mix with the air in the garage.

The apparatus bay should also have a dedicated HVAC system separate from green zones. This further isolates contaminants and prevents them from entering zones with lower contamination.

Recently published results of a Harvard study show the positive impact of isolating apparatus bays from living areas. The study compared three older fire stations with one newly constructed. The newer station – which better separated the apparatus bay from living areas – had lower levels of potentially harmful particulate matter in living areas than the older stations.³

LIMITING CONTAMINANT EXPOSURE AT THE SCENE

While minimizing exposure to contaminants in fire stations is a concern for fire departments and municipalities, limiting exposure to carcinogens at the scene of a fire is a top priority. If more contaminants can be removed at the scene, fewer will return to the station.

PRACTICES TO REMOVE CARCINOGENS AND OTHER CONTAMINANTS AT THE SCENE INCLUDE:

- Hosing down the fire truck after the fire
- Removing contaminants from turnout gear via mobile washing stations, or removing and bagging turnout gear on-site before returning to the station
- Wiping contaminants from the face and neck with wet wipes





The Cottage Grove Fire Department's redesigned fire station includes a green zone with kitchen and living area.

RED ZONES OFFER AN IMPORTANT LINE OF DEFENSE AGAINST CONTAMINANTS

After exiting the fire truck, firefighters will use a red zone to clean turnout gear.

The red zone should be adjacent to apparatus bays and away from green zones so firefighters do not have to pass through cleaner environments to remove gear.

The area should include a washer and dryer, and space for temporary gear storage if all gear cannot be cleaned at the same time. The storage space should have negative air pressure so fumes emitted from contaminated gear are unable to enter other areas, and ductwork should pull air from the room and exhaust it outside. Stocking surgical gloves to remove soiled gear helps avoid skin exposure to contaminants.

YELLOW-ZONE DESIGN FURTHER LIMITS THE SPREAD OF CONTAMINANTS

Yellow zones offer a barrier between red and green zones. Specific design features encourage best practices to avoid the spread of contaminants.

The yellow zone should include an area for self-hygiene. Aromatic hydrocarbons and other harmful combustion gases from fires can seep through turnout gear and come in contact with the skin and bloodstream, where they circulate to the kidneys, liver and other organs. This makes it essential for fire personnel to clean their clothing and shower as soon as possible after a fire.

Additional yellow-zone features may include a low-temperature infrared sauna and workout room, so toxins can leave the body through

sweat. A second shower should follow these activities to rinse toxins off the skin's surface.

Sealed doorways are an important design factor to limit cross-contamination between zones. Self-closing doors are a popular option, and a smoke-seal gasket around the door system ensures no air moves through cracks. Materials in the yellow zone should be durable and easy to clean. Laminate or tile flooring is preferred over carpet.

Signs should be posted on both sides of entryways to remind personnel to double check for contaminated gear as they enter the different zones. A hand sink and boot wash allow for a final cleanup, if needed, without requiring firefighters to backtrack through a red zone.

In addition to a yellow zone that passes from red to green, an additional yellow zone may be set up for firefighters to store clean gear and dress before responding to a fire. To limit the impact on response times, this additional zone can be adjacent to the apparatus bay where clean turnout gear is always available and close to the fire trucks.

GREEN ZONES OFFER THE PUREST ENVIRONMENT FOR FIRE PERSONNEL

Firefighters and administrative personnel spend most of their working time in green zones. Smart fire station design ensures these areas have the freshest air and lowest levels of contamination.

Green areas should have positive air pressure compared to other zones. Because air flows from positive to negative pressures, this ensures any airborne contaminants from yellow and red zones won't seep into the fresh air of living

SEVEN DECONTAMINATION DESIGN FEATURES TO RETROFIT YOUR FIRE STATION

Decontamination is an essential strategy for all fire stations, not only new construction. These seven ideas can be retrofitted into existing stations to help improve fire personnel health and safety.

- Dedicate separate HVAC systems for the apparatus bay and green zones
- Install direct-capture systems for vehicle exhaust
- Install a shower and infrared sauna in red zones to help wash and remove toxins from the body
- Add boot wash stations to yellow zones so dirty boots don't enter living areas
- Make sure any food storage, including ice machines, are in green zones only
- Add signage to both sides of doorways to remind personnel to double check for contaminated gear before they enter a new zone
- Dedicate time for ongoing education about decontamination practices





The Cottage Grove Fire Department's reception area and offices are part of the station's green zone.

spaces. A dedicated HVAC system separate from other areas is also recommended for air quality.

On-site training rooms are another key feature of green zones, and are important for educating fire personnel on the newest practices related to decontamination. Ongoing training can help fire personnel identify risks of contamination and reinforce proper decontamination techniques.

WORK WITH FIRE STATION DESIGN EXPERTS TO CREATE SAFER SPACES FOR YOUR DEPARTMENT

Decreasing fire station contaminants to improve firefighter health and safety is a growing priority for communities as more is learned about the link between fire-generated contaminants and health.

The long-term implications are significant to these dedicated professionals that work to keep their communities safe, and extend well beyond the scene of the fire.

To meet this need, architecture firms are developing new design approaches to support a department's decontamination practices.

Wold Architects and Engineers has decades of experience building and renovating fire stations, and can work with your department to develop a customized zoned approach that limits the risk of contaminant exposure without impacting response time.

For more information and to discuss opportunities for your community, call 1-888-254-6789 or email info@woldae.com.

ABOUT THE AUTHORS



Matt Bickel, AIA, LEED AP

As an architect and partner, Matt has spent his entire 17-year career at Wold working with municipal and government clients across the Midwest to plan, design and implement their public safety facilities – both new construction and renovations. He is proud of relationships that are forged as Wold partners with communities to successfully translate their unique goals and realize their shared facilities visions.



John McNamara, AIA, LEED AP

John is a partner at Wold and has special expertise in the planning and programming of public safety facilities that convey the operational objectives of the client. John has over 30 years of experience in architecture and has been working at Wold for over 20 years.



Jake Wollensak, AIA

Jake is a registered architect who has a strong passion for helping clients design and develop public facilities that reflect the values of their communities. Jake specializes in public safety design, where he enjoys the challenge of creating safe, secure and effective workplaces.

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2. “The Fire Service Cancer Toolkit.” Fire Service Occupational Cancer Alliance, First Responder Center for Excellence, September 2017. <https://www.nfpa.org/-/media/Files/News-and-Research/Resources/Fire-service/CancerToolkitv6.ashx?la=en>

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