Shopping around

Shopping malls, retail stores, and strip malls pose many challenges to fire protection, lighting, mechanical, and electrical engineers.

BY JENNI SPINNER, *Contributing Editor*

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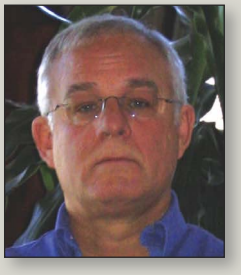

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CSE: What engineering challenges do retail stores pose that are different from other structures?

Joseph A. Cappuccio: From a fire protection viewpoint, egress may be one of the more challenging aspects to retail occupancies. Often, back-of-house doors are provided with delayed locking mechanisms to prevent theft, which can slow exiting. Often the fronts of stores have configurations that funnel occupants through check-out counters, which also can inhibit egress. Current building and life safety codes attempt to address these concerns, and having experience with these code stipulations can assist with developing layouts that meet consensus standards.

Douglas H. Evans: The most common active fire protection system required for retail stores is automatic sprinklers. As structures increase in height and size, the complexity increases accordingly. In addition to sprinklers, this may include increasing fire-resistive construction, egress systems, and the complexity of the fire alarm system. Firewalls, also known as maximum foreseeable loss walls, are common in strip malls to limit increased fire-resistive construction aspects of contiguous structures. Some retail stores stock products that are regulated as hazardous materials. This typically includes oxidizing materials, such as chlorine, as well as flammable and combustible liquids. Big-box stores frequently require specialized sprinklers to protect the rack storage areas. From a fire protection standpoint, malls are the most complicated retail structures; they require zoned sprinklers, smoke-control systems, secondary power supplies, fire-resistive compartmentalization, and a fire alarm system sufficiently complicated to provide the required communication between active systems.

Keith Lane: Lighting, especially in high-end stores, plays a major role in the design. With the ever-tightening energy codes and reduction of exceptions, providing good lighting and meeting or exceeding energy codes (in the case of U.S. Green Building Council LEED projects) can be a challenge. The new technologies available, especially in the area of LED lighting, have increased the choices for lighting designers and allowed for quality, more efficient lighting.

Kevin M. Olsavsky: Retail stores require engineered systems that accommodate highly variable conditions of occupancy well and are highly efficient yet are very cost-effective.

CSE: How have the needs and characteristics of retail stores changed in recent years?

Lane: Owners of retail stores are expecting higher quality lighting and system flexibility, but do not expect to pay a premium for these systems. High-quality designs are required to achieve both.

Olsavsky: The basic needs of the retail environment haven't changed dramatically, though the average square footage of retail stores has increased with the continued prevalence of big-box retailers.

Cappuccio: The increased amount of interior displays of hanging clothing, and reduced aisle widths due to shelved items, have caused difficulties in properly devising egress paths. Storage areas have also become a challenge with regard to identifying the appropriate sprinkler hazard and correct design.

According to Clark County (Nevada) fire protection engineer Douglas H. Evans, the Crystals complex in Las Vegas' CityCenter proved to be challenging. Portions of this mall are more than 85 ft high, leading to complex sprinkler and fire protection systems. Courtesy: MGM Resorts

CSE: How do the concerns of a freestanding retail store differ from those of stores in a strip mall or mall complex?

Olsavsky: Retail spaces in a shopping center or enclosed mall have a greater potential to benefit from shared central monitoring and evaluation (M/E) systems, though apportionment of costs requires proper attention to detail in design.

Evans: As structures increase in size, the fire-related concerns increase accordingly. These include a safe environment and limiting property damage.

Lane: Strip malls can be designed with some diversity considerations of the net loading for multiple stores. Strip malls also require submetering; there can be code and cost allocations involved.

Cappuccio: The needs of the freestanding store and those stores located in a strip or indoor mall differ in several ways. Depending on the size of the freestanding store, very little fire protection and life safety features or systems, such as fire alarm detection and notification or automatic sprinklers, are required by current U.S. codes. Indoor shopping malls require a complicated mix of fire protection features that are interconnected, such as fire alarm and automatic suppression and smoke control. In strip mall-type shopping centers, there are likely a wide assortment of fire protection features, such as sprinklers and fire alarm systems, but with less interconnection.

CSE: Please describe a retail store project you've worked on—share challenges you encountered, how you solved them, and engineering aspects you're especially proud of.

Cappuccio: The last truly complicated retail project that I worked on was about 5 years ago. It was located in the Middle East, and they wanted to meet U.S./Western codes. The facility was a huge indoor shopping mall with almost every type of occupancy: retail and assembly (restaurants and a seven-screen movie theater located on an upper level). The project had complicated egress routing due to its size and configuration. It also required smoke control as it was a multistory mall. Many of the issues had to be addressed through performance-based design techniques using computer-based fire modeling and egress modeling.

Evans: The Las Vegas Strip includes freestanding covered mall buildings and several large retail complexes inside the resorts. The most recent of these is part of the CityCenter complex known as Crystals. Portions of this mall are more than 85 ft high. To ensure proper sprinkler protection, the design incorporated deluge sprinklers activated by multiple fire signatures, which included a combination of smoke detection, UV/IR, and/or video detection. These detection methods also were used to activate the zoned smoke control systems.

Lane: In a recent project we completed for a large mixed-use facility, a significant portion was for retail. The retail ranged from a large grocery store to small outlet stores to numerous specialty stores to restaurants. The owner did not want to pay for the larger electrical service and electrical infrastructure required for the higher power densities often required in restaurants. Cooking equipment and machines use significantly more power than a typical department store. Depending on the square foot allocation between the actual kitchen and the restaurant and the type of equipment, densities can be in excess of 75 W/per sq ft. Our firm provided significant data on the type of densities required for the plan spaces, and the owner decided to future-proof the project by investing in the larger electrical service and infrastructure.

Olsavsky: Most challenges involve work around adjacent retail or common spaces, many of which have elaborate finishes. One project involved a spa with significant plumbing requirements located above an elaborate space for a clothing retailer. Creative solutions were required to avoid disruption to the adjacent spaces during construction.

CSE: What factors do you need to take into account when designing building automation and controls for retail stores?

Olsavsky: Simplicity and cost-effectiveness are always imperatives in the retail environment. Flexibility to accommodate changes in the configuration of the sales floor without significant system modifications is also very important.

Evans: From a fire protection standpoint, the complexity of the smoke-control system is the primary controls challenge. This can be accomplished through the fire alarm system or BMS.

CSE: How have changing HVAC, fire protection, life safety, and/or electrical codes and standards affected your work on such structures?

Cappuccio: I don't believe that the fire protection related codes have changed much, but the owners' visions for designing landmark facilities and attracting noteworthy tenants result in most of the challenges to meeting prescriptive fire protection and life safety codes. This has required, and may continue to lead to, the use of performance-based design techniques to resolve code compliance challenges.

Evans: The 2012 International Building Code has revised the covered mall buildings requirements in Section 402 to include a new category for open mall buildings.

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Olsavsky: The evolution of life safety codes has increased the need for proper smoke control in enclosed malls, requiring much closer coordination between the architectural, life safety, and mechanical disciplines to ensure a coordinated approach to zoning, physical separations, and control of equipment/system operation. Continued development of energy codes and attention to sustainability have increased ventilation rates and use of strategies like economizer cycles and other strategies requiring proper attention to the design of control systems.

CSE: What's the one factor most commonly overlooked in electrical systems in retail stores?

Olsavsky: The factor is proper attention to lighting controls to make them straightforward for staff to understand and operate.

Lane: Providing the electrical infrastructure required for expansion or to attract the widest range of potential clients is often overlooked. It is easy to low-ball the expected power requirements when building the core and shell of a building, but I have seen projects pay dearly when they are unable to provide power for power-dense customers like restaurants and other retail facilities with some manufacturing component. Providing the right balance of power infrastructure and cost while having the ability to attract the widest range of clients is essential.

Evans: The most commonly overlooked electrical aspect is the standby power frequently required for elevators serving multilevel retail tenants in high-rise buildings.

CSE: What types of electrical products do you most commonly specify in a retail store, and why?

Olsavsky: Aside from routine wiring devices and circuiting, we usually specify a variety of modular raceways to provide flexibility and integrate with millwork and displays in an aesthetically acceptable manner.

Evans: As a jurisdictional representative, we don't specify products. The adopted codes and standards require products intended to provide specific levels of protection, such as fire alarm systems and secondary power supplies. When the BMS operates the smoke-control system, it is required to be listed in accordance with UL 864.

CSE: Retail stores, especially high-end ones, often are specific and exacting about ensuring their wares are displayed in the best possible light. What lighting challenges have you faced, and how have you met your clients' high standards?

Lane: Many clients are aware of the "new" LED lighting and some have very high expectations of the technology. LED lighting has improved significantly, but efficiency claims and lamp life are still over-bloated. Certain locations and uses are well suited for LED lighting, but other sources like MR-16, metal halide, and fluorescent light sources are preferred for many areas of lighting.

Olsavsky: Accurate color rendering and the use of sources with the proper specularity are essential to proper display of merchandise. Achieving these objectives while also meeting energy codes is challenging, but new sources which help to achieve these competing goals are continually being developed.

MEP Roundtable

CSE: How have sustainability requirements affected how you approach electrical systems?

Lane: It is difficult providing quality lighting and meeting ever-more stringent energy codes. LEED projects often require lighting densities a minimum of 20% less than energy codes. Lighting controls and occupant use of high-end controls are also used on sustainable projects. Overall percent loading on transformers and the use of TP1 transformers are also design considerations to provide more efficiency. The use of VFDs and more efficient motors and mechanical systems and free cooling with evaporative cooling are all part of today's modern energy-efficient designs.

Olsavsky: Sustainability requirements and ever-more stringent energy standards have challenged us to design more efficient lighting systems and more effective lighting control systems, all while minding the client's project budget.

CSE: Complex metering and submetering often are called for in strip malls and mall complexes. What challenges do such systems pose, and how do you overcome them?

Lane: Some jurisdictions do not allow submetering. Others allow for submetering as long as no profit is made from selling back power. Owners will often have to prove that no profit is made from charging retail facilities for power The designer must ensure that the type and quality of meter is approved by the authority having jurisdiction (AHJ) and that the system comes with software that will allow for adequate documentation of power used by each retail facility and the charges applied for the power used.

Olsavsky: Check metering systems for allocation of costs often involve multiple utility systems (i.e., power, chilled water, hot water, gas), which are installed by multiple trades. Proper attention to detail is required to provide an integrated metering system with convenient central reporting for all the required utilities that can be installed without creating conflicts between subcontractors.

"Retail spaces in a shopping center or enclosed mall have a greater potential to benefit from shared central monitoring and evaluation (M/E) systems." *- Kevin M. Olsavsky*

CSE: What trends, systems, or products have affected changes in life safety systems in retail stores and malls? Please include clean agent fire suppression systems, notification systems, etc.

Evans: These days, automatic sprinklers are required in virtually all retail structures. Over the past 20 years, big-box stores have become more popular. The automatic sprinkler systems have been revised accordingly to include protection of the rack storage areas. The covered mall provisions were initially developed in the late 1970s. At that time, the expected uses were primarily retail. Over the past 20 years, there has been a transition to more and more assembly use, primarily restaurants/dining. This has been recognized in the International Building Code by eliminating the previous 25% limitation for uses other than retail. As these structures increase in size, the need for appropriately zoned fire alarm notification systems, and possibility mass notification systems, increases proportionally.

Cappuccio: Perhaps the biggest challenge with regard to trends relates to intelligibility of fire alarm systems. The echo that results in shopping malls can create a challenging environment to meet intelligibility requirements for voice notification fire alarm systems.

CSE: What fire/life safety lessons have you learned on past retail store projects?

Cappuccio: The design of large shopping facilities is complicated. There are multiple fire protection and life safety systems that need to interact with each other and in some cases with the building's electrical and mechanical systems as well. These projects are often on an extremely tight construction schedule, and even the best-designed fire and life safety systems require oversight during installation to prelude delays in obtaining local code authority approvals for occupancy permits.

CSE: What are some important factors to consider when designing a fire and life safety system in a large mall? What things often get overlooked?

Olsavsky: Proper integration between tenant fire protection subsystems and the central, common area life safety systems is essential. In large malls, complex space geometries and the need for smoke control systems can also create zoning issues requiring close coordination between the architectural, fire alarm, fire protection, and HVAC disciplines.

Cappuccio: Important factors to consider when designing the fire protection and life safety for a large mall include identifying the correct hazard level and correct zoning of the various systems and features (active and passive systems and features) so that the intended design works when installed. Coordination among the various design disciplines is very important. Lastly, these large facilities have more commonly seemed to need performance-based (modeling) approaches to resolve challenges with meeting prescriptive code requirements.

Evans: The fire protection requirements for most structures are typically

the responsibility of the design professional and contractor that specialize in the respective area (e.g., electrical, HVAC/smoke control, passive fire resistive aspects, elevator systems, sprinklers, fire alarm). In Clark County, a specific document is required that focuses on a consolidated approach to fire protection for such structures. Through this process, coordination of fire protection aspects and the expected results are agreed to during the design phase. This approach substantially reduces the number of aspects that are overlooked.

"Depending on the size of the freestanding store, very little fire protection and life safety features or systems, such as fire alarm detection and notification or automatic sprinklers, are required by current U.S. codes." *- Joseph A. Cappuccio*

CSE: What specialized fire/life safety systems products have you specified in retail stores and malls (e.g., mass notification systems)?

Evans: As a jurisdictional representative, we don't specify products. The adopted codes and standards require products intended to provide specific levels of protection. When roofs and/or ceilings exceed reasonable heights (50 ft), there is less assurance automatic sprinklers will activate properly or be able to control a fire. In these situations, the design frequently includes automatically activated deluge-type sprinkler systems. As the facility becomes larger, the need to provide occupants appropriate information increases accordingly. In these facilities, a mass notification system may be appropriate.

CSE: How do you ensure merchandise is safe from fire while not damaged by fire protection systems?

Evans: It is virtually impossible to "ensure" that merchandise is "safe" from the effects of fire, including smoke damage. Automatic sprinklers substantially reduce damage caused by fire and smoke to both structures and merchandise. Smoke-control systems limit smoke migration to assist in occupant safety and may also help to reduce property loss. While water damage from sprinkler systems has and does occur, these losses are substantially lower than the losses from fire that would occur without them.

Cappuccio: If a fire occurs, the smoke, heat, and other products of combustion will damage the merchandise throughout a facility if the fire is not suppressed or extinguished during relatively early stages of development. So, the question is less about damage during a fire event, as that will occur from the fire and some collateral damage from automatic suppression systems to a portion of merchandise seems a better option than losing everything. Protecting merchandise from fire protection systems during nonfire events is an issue of proper inspection and maintenance and some common sense: don't knock the sprinkler with a ladder, and it's unlikely to leak dramatically. Regular inspection and testing should keep the systems from unwanted discharge and indicate potential for leaking (corrosion sightings, for example).

CSE: What unique requirements do HVAC systems in retail stores have, and how have they changed in recent years?

Olsavsky: HVAC systems for retail environments must accommodate highly variable conditions of occupancy well and provide flexibility for varying store layouts without requiring significant and costly modifications. They must address relatively high traffic at entrance points and be highly efficient yet very cost-effective.

CSE: How do HVAC systems differ between freestanding stores, malls, and other structures?

Evans: The HVAC systems in malls are frequently used to fulfill the smoke-control requirements. When this is the case, a number of additional features are required. This includes automatic and manual controls, monitoring status of fans and dampers, and secondary power supplies.

Olsavsky: Retail spaces in a shopping center or enclosed mall have a greater potential to benefit from shared central M/E systems, though apportionment of costs requires proper attention to detail in design. Large freestanding stores can leverage their economies of scale to use higher efficiency systems than smaller stand-alone stores can.

CSE: Many mall complex structures include fountains, live plants, and other features requiring irrigation systems, humidity control, and complex plumbing. How do such features affect your work?

Evans: From a fire protection focus, these features are great. They reduce the fire hazard within the building. Even live plants that are properly hydrated and well maintained typically aren't a fire hazard. These features also create areas within the facility that aren't occupied by the public and therefore can reduce the needed egress width.

Olsavsky: HVAC systems for these areas require proper zoning, ventilation rates, and control of pressure relationships to prevent migration of odors. Plumbing systems for decorative fountains require proper attention to filtration to minimize operational issues and maintenance on the overall system. csel