

SECURITY BEGINS WHEN YOU CLOSE THE DOOR

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High-security entrance to the new Sandy Hook School, Newtown, Conn.



LEARNING OBJECTIVES

After reading this article, you should be able to:

- + **COMPARE** the competing priorities of security and fall protection against the needs for unimpeded egress and fire safety.
- + **DISCUSS** the reasons for using locking door hardware for school classrooms, and the solutions for these applications.
- + **LIST** the systems and products used for access control, intrusion and ballistic protection, and fall prevention.
- + **DESCRIBE** the safety and security implications of door and window products, including glass, framing, and hardware.

Selecting door and window systems for any building project demands a complete articulation of safety and security concerns. Balancing life-safety performance and integration with overall security planning is one of the most difficult aspects of fenestration design.

According to Safe Havens International, security and safety in the design of new buildings include proper egress, improved *natural surveillance* (the ability for people to see their surroundings and be seen by others), and heightened situational awareness through the use of windows and

BALANCING LIFE SAFETY CONCERNS AGAINST THE DEMANDS OF SECURITY PLANNING POSES A COMPLEX PROBLEM FOR DESIGN TEAMS.

other means. Visibility in and out of the building is often just as important as hardening the fenestration elements, says Safe Havens. Another useful technique: *natural access control*, which Safe Havens defines as “designs that control access through a building by channeling visitors through areas where they can be observed by staff.”

The Window and Door Manufacturers Association (www.wdma.com) and the National Safety Council (www.nsc.org) have collaborated to develop new standards and encourage better product designs. Their work “emphasizes the life-saving role doors and windows play as the primary exits and secondary means of escape in the event of a fire,” says Joel Holand, a consultant with the KDB Group and former president of WDMA.

As components of the life-safety and fire-safety systems, doors and windows can provide means of escape. Yet both also serve as possible entry points for intruders, whether at street-facing doors and windows or at the thresholds to vulnerable and sensitive areas inside. A few new fenestration techniques and system features help address these vulnerabilities.

OPTIMIZING PERIMETER SECURITY AND OCCUPANT SAFETY

Balancing the needs for code-mandated life safety against the prerogatives of security planning is a

challenging aspect of building design. To fortify facility perimeters, designers can choose security bars, grilles, roll-down shutters, or window guards and grates. All are effective for thwarting intruders, but they also lock in occupants and may not suit the project’s aesthetics, says the WDMA.

By code, emergency egress must be available to and usable by all occupants “without need of keys, tools, or special knowledge” of egress products. In addition, certain security features, if improperly manufactured or installed, may actually undermine protection.

One valuable design guideline for top-level thinking on both security and life safety comes from the U.S. Department of Homeland Security, which recently reissued its “Building Vulnerability Assessment Checklist.” Among its detailed recommendations:

- **Exterior doors.** Door designs should minimize exposed hardware and employ hinges with non-removable pins. Do not use handles, key-in-knob locks, or protruding locks from the outside of all exit-only doors. Consider alternatives such as operation from the outside with a proximity card reader. Ideal door designs are fully framed with sturdy materials like steel, aluminum alloy, or solid-core hardwood, as well as breakage-resistant tempered glass. Flush-mount all door locks.
- **Exterior door hardware.** Fit all secure entries with swinging doors with a minimum one-inch deadbolt lock and a one-inch throw bolt and hardened steel insert, a free-turning brass



A new buzzer system installed at Worthington (Ohio) School District.



COURTESY/EXPONENTIAL IMPACT

or steel-tapered guard. "If glass is within 40 inches of the locking mechanism, the doors should have double cylinder locks," says the Homeland Security advisory. Protect panic bar latches with pick plates to limit lock tampering. Cover the gap between doors with metal plates.

■ **Interior door hardware.** Changes to interior doors may also be warranted. In the last few years, hospitals and schools have been upgrading their door packages with fortified specifications and targeted retrofits.

In Colorado, a sweeping state code change by the Division of Fire Prevention and Control has called for school districts and junior colleges to upgrade all classroom door hardware if the openings can be locked from the inside, so that teachers and students can lock up without leaving their classrooms.

"It creates a barrier," says Michael Eaton, Chief of Department Safety for Denver Public Schools. "The whole point of school safety is not only prevention but how do we create barriers to individuals who want to do harm to our schools to allow us time to get emergency personnel there to eliminate the threat."

Some architects and construction experts see hardware upgrades as a sensible and subtle way to improve security, but admit there are tradeoffs. Architect Jack M. Mousseau, AIA, LEED AP, a Principal with MOA Architecture, Denver, told the *Denver Post*, "We don't want to turn our schools into more hardened and protected environments so that the security process becomes much more like going to the airport than going to school. That's not a reflection of the society we want our kids to grow up in, but we also want them to grow up, right?"

According to the Door and Hardware Institute (www.dhi.org), many schools have migrated to *classroom locking*. Piedmont Unified School District, which serves 2,500 students in a community surrounded by Oakland, Calif., retrofitted classroom locks several years ago so that they could be locked from inside the classroom with a key, with an added luminescent touchpad feature. Pushbar exit devices

also were replaced with glow-in-the-dark touchpad devices, which make it easier to find the exit during a power failure. A new keyway, geographically restricted for the Piedmont zip code, controls key cutting and distribution.

Keyed solutions are no longer in favor in certain circles. In 2015 the NFPA 101 technical committee related to educational occupancies organized a working group to tackle classroom door-locking devices to prevent unwanted entry, says Ron Coté, NFPA Technical Services Lead for life safety. They developed criteria that required the ability to unlock and unlatch from the classroom side of the door without the use of a key or tool, and without any special knowledge or effort, using not more than two releasing operations. (Previously, a single-operation rule as required by egress doors was mandated.)

Other criteria include locking means that don't require opening the door, so that classroom occupants will not inadvertently signal to others outside the room that they're locking down. The NFPA group's criteria also limit mounting heights and require locking means that won't modify door closers or panic hardware. Locks may engage remotely, such as from the principal's office, but still must be unlockable from inside the classroom, according to NFPA's Coté.

ACCESS CONTROL WITH ENHANCED INTRUSION DETECTION

In school settings as well as retail, office, and multifamily buildings, other techniques assist in protecting against the rare outside threat. Supplementing access control with intrusion detection can improve the ability to thwart entry by unauthorized visitors. Intrusion detection products are sensor-based, integrated technologies. Like motion sensors, they can indicate possible unwanted entry into a building, but they also include *position sensors* for doors and windows, *glassbreak detectors*, and panic buttons.

Position sensors are typically concealed in drilled, recessed openings in steel-framed openings. They send status signals to a central control panel, which can be



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Exterior view (top) and interior view (above) of safety entrances with interlocking doors designated by the DHS as a "qualified anti-terrorism technology."

read by building staff on a keypad or smartphone, or by using a workstation for the building automation system. Some sensors have addressable zone expansion, which allows multiple devices or zones to be served by the same pair of wires, which reduces installation complexity and cost. These low-cost position sensors are commonly used in energy-management and annunciation applications, as well as in access and intrusion systems. They work well for data centers, hospitals, banks, kitchen facilities, and even restrooms.

Glassbreak detectors are less common but useful in certain settings. Activated by the sound

of breakage, wall- or ceiling-mounted microphone sensors analyze sonic patterns to recognize breaking glass. In positive events, the detector notifies a system control panel. Other breakage detectors are mounted directly to glass panels on insulated glazing units to monitor vibrations; if the movements exceed a specified frequency or force, the detectors assess and signal the event.

Panic buttons allow for operators and employees to announce unwanted visitors or security threats in a discrete manner. Bringing people into perimeter security protection is essential, as is using fortified and architecturally protected elements, says Richard Cantor, a Principal of Cantor-Pecorella, a residential real estate company. He says that many renovated older buildings with masonry walls, shapely windows, and quiet central courtyards often provide a level of safe, blast-proof security and privacy along with a sense of elegance and style that new glass condominium towers can't match.

The adaptive reuse of 443 Greenwich, a new loft project in New York City's Tribeca neighborhood, reinvents an 1880s bookbindery with massive red-brick walls and arched windows. Adding high-tech perimeter control systems and creating a secured drive-in entry through original wrought-iron gates to a lower-level garage lobby lined in Guastavino tile arches, the new multifamily design has attracted A-list celebrities and high-flying financiers with its "paparazzi-proof refuge and privacy," says Cantor. After secure entry by car, the underground lobby's nearly full-block-long size allows for multiple elevator banks leading directly to residences.

BLAST PROTECTION, BALLISTIC GLAZING

Glass and polycarbonate technologies are improving the performance of transparent exterior assemblies, from windows and glass doors to curtain wall.

Fully tempered glass and *laminated glass* are two common specifications for door and window products requiring safety glazing. Tempered glass reduces the risk of injury to occupants by breaking up into small fragments upon being shattered. Laminated glass holds the fractured glass in place, adhered to by a polyvinyl butyral (PVB) interlayer to limit the movement or fallout of glass fragments. This even includes defense against spalling, the exit of glass in transparent armor glazings toward the protected side during an attack. "Low-spalling" and "no-spalling" are

two levels that can be specified for windows, doors, and partitions.

“Bullet-resistant products are engineered for protection against a wide range of ballistic threat levels,” according to engineers at Consolidated Glass Holdings. “All combine multiple layers of glass and PVB with no-spall protection and UL listings for various levels of protection.”

Glass-clad polycarbonates combine the durability and abrasion resistance of glass on the “attack” side and the impact resistance of polycarbonate on the “witness” side. They are thinner and lighter than other products and offer “no spall” protection. *Laminated polycarbonates* are made with polyurethane interlayers to achieve ballistic and impact resistance, adds CGH. These include *air-gap units* that combine laminated glass with laminated polycarbonate. Some advanced glazings combine glass, polycarbonate, and a proprietary polymer for a relatively lightweight, high-ballistic-rated solution.

Bullet-resistant fiberglass and ballistic acrylic and fiberglass

predominate. Lobbies and reception areas must be armored to resist handgun fire, generally with UL Level 3 materials. The exteriors of remote government border facilities must be paneled in an underlayer of Level 4 bullet-resistant fiberglass. Exterior windows must be fitted with Level 4 glass-clad polycarbonate ballistic transparency and “true UL-rated frames,” says Richards, whose company designs, fabricates, and installs custom bulletproof barriers. He warns that government-grade materials are “significantly more challenging to work with” than the commonplace Level 3 ballistic acrylic and fiberglass that many glaziers are accustomed to using.

BEEFING UP FALL PROTECTION

Schools and multifamily buildings must also guard against falls through window openings, says window expert Mark Meshulam. *Fall protection* is essential even in low-rise structures. A study reported in *Pediatrics*, the journal of the American Academy of Pediatrics, showed that 98,400 children injured in falls from windows were treated in U.S. hospital emergency departments over a 19-year period. Most of the falls (63%) were from second-story windows. About a third were from first-story openings. Only 6% of all fallout incidents occurred from three stories or higher.

A variety of protective hardware types and guard products can be used to prevent building occupants from falling through a window or door. (The use of screens, such as insect screens, to prevent falls may violate codes in many jurisdictions.) The U.S. Consumer Product Safety Commission recommends using window guards and window limit stops, which can stop windows from opening more than four inches. Facility managers often choose to install and operate windows so they open from the top, rather than the bottom. In certain interior settings, designers locate furniture mindfully to prevent fall dangers, such as by preventing unwanted access to windowsills and openings.

So-called “hopper windows” are frequently used in today’s mixed-use, hotel, and multifamily buildings constructed with glass window walls and curtain wall, where the openings may reach all the way to the floor. Also known as *project-in windows*, hoppers are similar in construction to awning windows, or project-out types, and casement windows with their side-hinged inswing or outswing operation.

In the case of hopper windows, says Meshulam, “Two main devices for limiting sash travel are used: a limit device that attaches to sash and frame and

A classroom cylindrical lock designed to impede an intruder.



MOST CHILDREN WHO FALL FROM WINDOWS DO SO FROM THE SECOND STORY, NOT HIGH UP.

are also available.

According to Jim Richards, CEO of specialty contractor Total Security Solutions, Flowerville, Mich., UL provides a performance category breakdown of the glazing types, which the company employs in government work such as U.S. Customs border stations. UL Standard 752, “The Standard of Safety for Bullet-Resisting Equipment,” includes seven levels of protective barriers, beginning with:

- Level 1: Stops three shots from a common 9mm sidearm
- Level 2: Stops three shots from a .357 Magnum
- Level 3: Stops three shots from a .44 Magnum ... and so on. Level 4 is for a hunting rifle. Level 6 tests against a five-shot burst of 9mm ammunition. Level 7 is for faster-moving but lighter bullets, says Richards.

For government projects, a few standard specifi-



Curtain wall with hopper-style window by Boston Aluminum & Glass, part of a structural glazing curtain-wall system.

constrains sash travel to prevent openings large enough for child window falls.” In a typical hopper hinge, a metal shoe travels along the hinge track. With a metal bar fixed in place in the track, the sash opening is limited to a fixed dimension.

The Boston Health Commission has issued guidelines for child-safety window guards, which must be constructed with aluminum or steel

bars spaced no more than four inches apart when installed in the window frame. The products should be designed and tested to withstand 150 pounds of pressure. They are recommended for the second story and above and for the first floor if the window is over 12 feet high. The Boston Fire Department recommends operable release-


type guards, to allow escape in the event of an emergency. Yet even though such measures are strongly recommended, fall guards are not required by law in Massachusetts and in many other states.

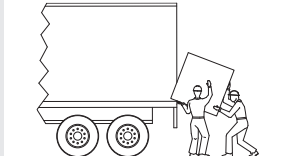
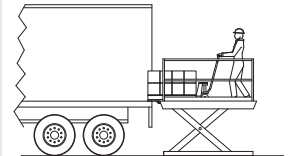
Still, *self-locking windows* are commonly used in high-rise and mid-rise residential buildings because they are strongly recommended by lawyers and preferred by most building owners and operators. In many cities, the limiting devices are required in every apartment with children under 11 years old.

FIRE SAFETY, OPENINGS, AND EGRESS

To make windows and glass doors more robust for fire protection, designers should employ fire-rated steel frames and fire-safe glazing such as wire glass and fire-rated ceramics, says Niklas Vigener, Senior Principal with engineering firm Simpson Gumpertz & Heger. Fully tempered knock-out glazing panels can be used for venting and emergency access from the exterior.

Any colored or tinted glazing must be reviewed




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for safety and security implications. During daylight hours, glazing with low visible light transmission (VLT) can actually hamper search-and-rescue operations by firefighters, police, and others who are trying to look inside endangered buildings. This concern also obtains at night, when emergency personnel inside the building try to see outdoors.

“Windows with safety glazing and impact-resistant glass add to the formula to provide a safe and secure environment,” including protecting against high winds and flying debris, says KDB Group’s Hoiland. “These products, especially those that provide storm resistance, make the premises safer by their sheer nature.”

Yet all these safety enhancements, from locked classrooms to impenetrable glass to self-locking windows, can also raise questions of safe egress. Do interior room locks slow evacuation procedures? If a window won’t open fully, does that hamper emergency egress and fire-rescue operations? In fact, most multifamily building codes strictly regulate minimum opening sizes for each sleeping

room. They usually require 5.7 sf of opening (5.0 sf of opening at grade level), an opening height of at least 24 inches, and a minimum width of 20 inches. To ease use, the sill height may not exceed 44 inches. The windows must be operational from inside without keys or tools or special knowledge, says Hoiland.

The Door Security & Safety Foundation is dedicated to building awareness around these essential functions and to ensuring the proper use of architectural openings through inspections, operations planning, and emergency drills. The group supports the annual fire/egress door inspection initiative, a recently added requirement of NFPA 80, “Standard for Fire Doors and Other Opening Protectives,” as well as its core life-safety code, NFPA 101, both included in the International Building Code and International Fire Code.

Annual inspections ensure that egress doors function properly. Yet this simple act also raises awareness of the essential role doors play in building security and life safety.+

+ EDITOR’S NOTE

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