Fire Engineering

Close

# Green Building Construction and Daylighting: A Chief Officer's Perspective

**BY RONALD R. SPADAFORA**

Green building structures, also known as sustainable buildings, are designed, built, renovated, and operated in an ecological manner. They are created to meet certain criteria: to protect occupant health; to improve employee productivity; to use water, energy, and material resources more efficiently; and to reduce the overall impact of building construction on the environment.

An important component of green building construction is the efficient use of natural light. Innovative methods are used in the design to draw more natural light into a building, improving the structure's visual environment. The more natural light brought in, the less reliant occupants will be on artificial lighting. To accomplish this goal, daylight must be admitted and distributed throughout the space as deeply and as evenly as possible. Natural light must be controlled so that the sun's rays do not penetrate into areas where they will cause discomfort or glare. The natural light must also be integrated with the electric lighting system.

Incorporating usable daylight into a building can add up to points in the Leadership in Energy and Environmental Design (LEED®) rating system™ established by the U.S. Green Building Council (USGBC). The USGBC is a nonprofit organization that certifies sustainable buildings as well as neighborhoods. The LEED® rating system™ is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. LEED® emphasizes state-of-the-art strategies in five areas: sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality (IEQ). It may, however, have a significant impact on the construction of a building's roof, walls, and interior design. It will also affect the way firefighters operate at incidents and access, ventilate, and egress structures during fire operations.

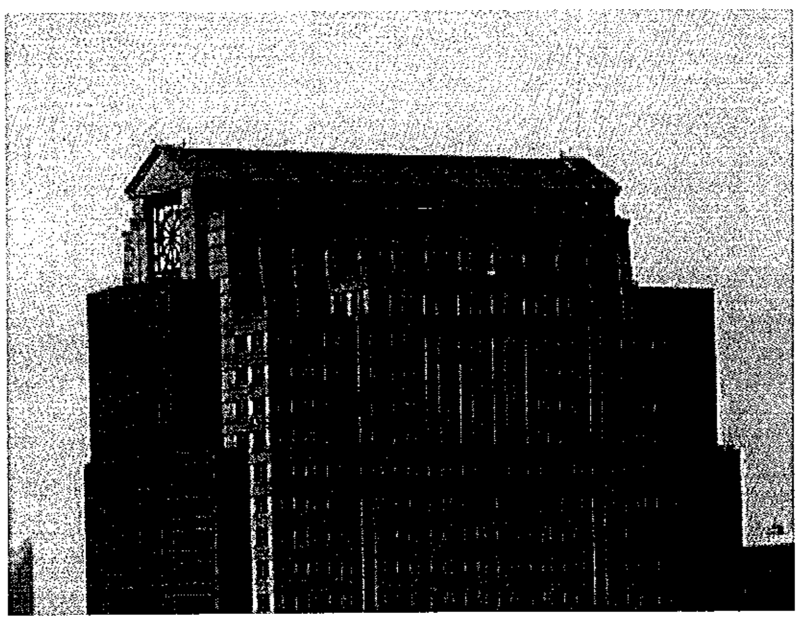
## DAYLIGHTING

Daylighting is an ancient architectural technique noted for its aesthetic and economic value. The concept places roof openings, windows, and glazing so that natural light is maximized to provide effective internal illumination during the day. Daylighting strategies can save electrical energy and reduce HVAC loads. Other benefits include enhanced visual comfort for occupants and improved worker productivity.

**Table 1. Design Feature Definitions**

| | |
|---|---|
| Atrium | Open area that interconnects a number of floor spaces within a building |
| Sawtooth roof | Comprised of a number of triangular-shaped parallel sections |
| Roof monitor | A raised section of roof that includes a vertically (or nearly vertically) glazed aperture for the purpose of illumination |
| Skylight | A relatively horizontal glazed roof aperture for the admission of daylight |
| Light court | A large shaft sometimes using the walls of its surroundings to reflect light |
| Clerestory windows | Vertical glazing high on a wall |
| Light shelf | A reflective, horizontal surface that can be installed on both the exterior and the interior of a building |
| Heliostat | Mirror that tracks the sun to reflect light |
| Synthetic wall window | Wall glazing located at ground level to provide natural light to below-grade areas |
| Deadlight | Fixed glass segment imbedded into cast-iron stair or sidewalk frames to facilitate natural light to subsurface areas |

The first essential step in daylighting is to create a building with maximum access to natural light. This article examines just a few of these design features affecting the fire service from a chief officer's point of view. A building's architectural configuration is directly related to distributing light in a structure. The structure's orientation, depth, and volume are key considerations for the builder. The east and west faces of a building are the most problematic for shielding interior spaces from direct sun. Daylight entering the north side of the building is generally easier to control than from other orientations because direct sunlight is limited.



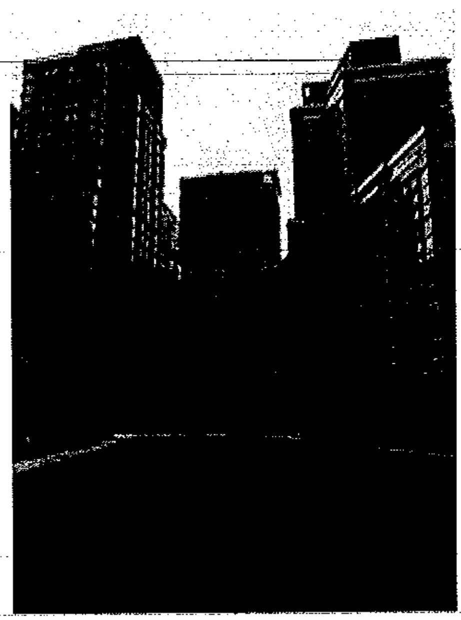
(1) A roof monitor atop a Tribeca (Triangle below Canal Street) high-rise office building in New York City. (Photos by author.)

At the roof level, atria, sawtooth roofs, roof monitors, and skylights can supplement the daylight in the center of a building by providing zenithal lighting. Light courts will bring natural light to the interior as well as the exterior of the building. At the upper sections of the building, clerestory windows can provide lateral natural light to interior areas near the perimeter walls. Windows on lower floors have less of an impact on daylight penetration. They can be enhanced, however, using light shelves and ground-mounted heliostats. Additionally, roof-mounted heliostats can be installed to reflect the sun's light rays around the exterior of the building. At the base of the building wall and at the sidewalk level, synthetic wall windows and deadlights are used to bring sunlight into below-grade areas.

# CHIEF CONCERNS

## Atria

Atria present some unique design concerns for the fire service. They interconnect a number of floor spaces within a building. The principle of compartmentalization to normally limit the spread of the products of combustion is compensated for by using automatic sprinkler systems, mechanical venting at the roof level and the use of the ceiling height and shape to create a smoke reservoir. Fire-generated smoke within an atrium will accumulate at the ceiling level and create what is known as a smoke layer. The height of this smoke layer is important when fire protection engineers design the smoke-management system. The goal in reaching a high level of life safety within an atrium space is obtained by keeping the smoke layer at the highest possible level (approximately 10 feet above the highest walking surface). This will limit the amount of smoke occupants will encounter while exiting the area.



(2) A U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) placard is proudly displayed adjacent to the main entrance of the Millennium Tower Residences building in Battery Park City.

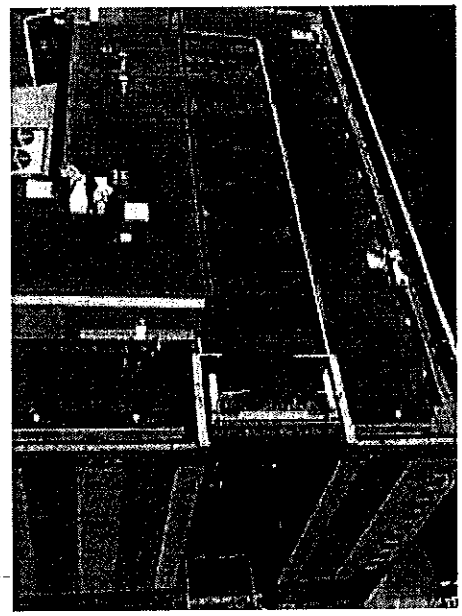
Venting with mechanical fans is the primary means used to begin exhausting the smoke from the atrium ceiling area. To effectively prevent the smoke layer from moving downward, it is generally necessary to incorporate an exhaust fan that will be large enough to remove the smoke at a rate at least equal to the rate at which it is being produced. The size of the fans and the required exhaust rate, however, may be significantly less than the smoke being produced by the fire in the atrium. In this scenario, the smoke layer underneath the ceiling could descend to the floor/balcony levels below, endangering occupants by the accumulation of toxic gases and hindering their movement toward the available means of egress.

Fire protection engineers often devise smoke-management systems based on an evaluation of fuel loads and the heat release rate anticipated within the atrium. To determine the appropriate size of exhaust fans, they use the equations in NFPA 92B, *Standard for Smoke Management for Malls, Atria, and Large Areas*. Ideally, they design a safe and tenable means of egress for building occupants in a fire and an adequate level of visibility for firefighters. A design error encountered for atrium smoke control is that only a single fire scenario or plume correlation is used. In reality, it is likely that multiple fire scenarios and plume types will be encountered, such as when an atrium is used as a temporary venue for exhibits and showrooms. This would add a substantial fire load that was not calculated into the design.

(3) Embassy Suites New York (Financial District) hotel's 15-story atrium. When designing safety features for atria, fire protection engineers seek to keep the products of combustion approximately 10 feet above the highest guest room walkway.

Chiefs must be vigilant in their guidance to building owners, managers, and agents regarding such ancillary shows. Additional fuel loading should be kept to a minimum to ensure atrium fire protection systems will not be overwhelmed and defeated. They should also preplan firefighting strategy and tactics to protect firefighting units against the use of conflicting hoselines. This dangerous situation can easily occur since atria often are designed with several entrances. Chief officers should stress to engine company officers that they must communicate with each other concerning hoseline stretches and placement during fire control and extinguishment operations to enhance safety. Search and rescue tactics must also be coordinated with ladder company officers so they do not position firefighters in line with hose streams or in precarious locations above the fire.

On arrival at the scene, determine the number of staircases that service the atrium, and ensure that proper designations are assigned to them ("attack" and "evacuation") during firefighting operations. Size-up must include the correct fire area by using accurate terminology to describe where in the structure the fire is located. Distinctions must be made between fire in the lobby of the atrium and on a balcony above.

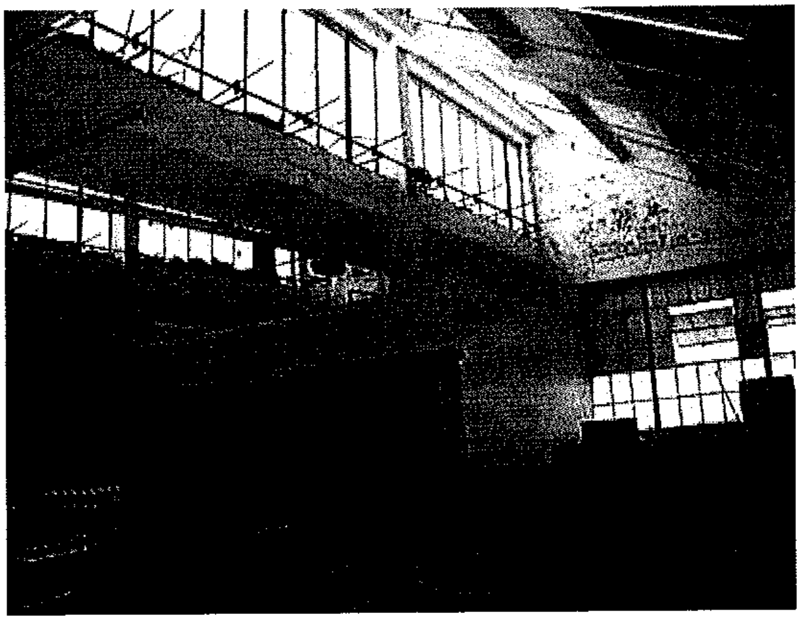


(4) A rooftop view of Embassy Suites reveals a comprehensive layout of atrium skylights and ventilation hatches. Chief officers should know how these features are controlled and operated automatically and manually by building maintenance engineers.

The accepted use of atria in green building construction allows the builder to take advantage of available sunlight as well as supply natural ventilation throughout the occupied area. It can, however, also provide a vertical flue for fire to spread quickly, endangering occupants who may be trapped in unprotected hallways, corridors, and passageways. Chief officers should review their authority having jurisdiction (AHJ) fire code regulations pertaining to the protection of atria using automatic sprinklers, smoke detectors, fire alarms, fire partitions/separations, and smoke-management equipment.

## Sawtooth Roofs

Using sawtooth roofs to enhance daylight more effectively is not new. These roofs have been around for centuries; they illuminated factories during the Industrial Revolution. This was especially true of textile mills in New England. The sawtooth roof was ideal for lighting large floor areas in wide buildings with low ceilings while minimizing the impact on the structure's overall height. Every bay of the roof has a sawtooth. The sawtooth roof design makes it possible to use all areas of the interior, furnishing northern light while excluding the sun's direct rays.



(5) Northern light from a sawtooth roof uniformly illuminates the interior space.

The sawtooth roof gets its name from its unique profile, which is similar to the teeth in a saw blade facing upward. Sawtooth roof design uses a number of triangular shaped parallel sections. This type of roof has two conspicuous exterior components: (1) vertical (or nearly vertical) glazing installed within a metal or a wooden sash, facing away from the equator side of the building to capture diffused light and (2) a gently sloping, opaque, solid roof surface.

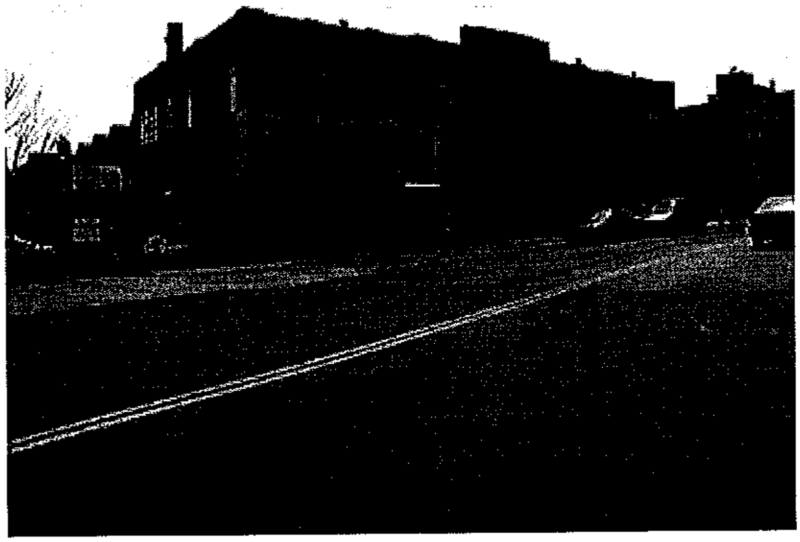
The valley gutter (a trough area separating one sawtooth section from another) is an additional feature of the sawtooth that chief officers must address. Firefighters commonly use them to traverse the roof. Ice, snow, and tree leaves naturally falling off the glazing of the sawtooth roof accumulate in these areas. Narrow gutters and clogged drains may cause large amounts of this material to build up. This will lead to dangerous operating conditions on the roof. Chiefs should advise operating members to move slowly, preferably in a crouched position, to ensure secure footing and a low center of gravity.

Sawtooth roofs may be constructed of heavy timber or steel truss structural elements. This special type of "inverted" truss does not have a pronounced telltale peak to warn firefighters of its existence. In addition, heavy timber trusses may have metal rods as bottom chord elements to carry tension loads to bearing walls. As with all truss roofs, sudden collapse without warning is always a real threat should the fire compromise the strength of any one component. They should also not be cut into for vertical ventilation purposes. For these reasons, it is imperative that chief officers investigate the type of construction that makes up the sawtooth roof. Direct interior firefighting forces to provide valuable reconnaissance concerning the structural elements that compose the roof structure.

(6) Vertical glazing, sloped roofing material, and valley gutters are major components of a sawtooth roof.

The roof's sawtooth shape may be completely invisible from the front of the building if it has a high cornice or façade. Responding units, however, may spot the configuration from the sides or the rear of the building. Company officers noting a sawtooth roof should communicate this information to the incident commander (IC) for relay to all on scene as well as arriving units. The corrugated design of this type of roof can be difficult to ladder. The framing of sawtooth roofs may be made of wood, steel, or reinforced concrete. When wood or steel is used, wood planking is commonly three or more inches thick, spanning bays from eight to 10 feet in width.

When sawtooth roof glazing has been covered over, you will need forcible entry tools to break/pry out an opening. Firefighters venting on the roof must be in communication with interior forces and confirm that the area inside the building directly below the venting operation has been cleared of all personnel. The speed and direction of the wind are extremely important to operating forces designated to ventilate a sawtooth roof. If the wind is blowing into this opening, cutting operations may be required on the leeward side for nontruss sawtooths. This would allow the products of combustion to readily escape from the building. The feasibility of cutting operations will be contingent on the valley gutter's having an adequate width.



(7) A chief officer standing in front of this Queens, New York City, warehouse would not be able to see its sawtooth roof, which is visible from the street at the Exposure 2 (B side) of the building.

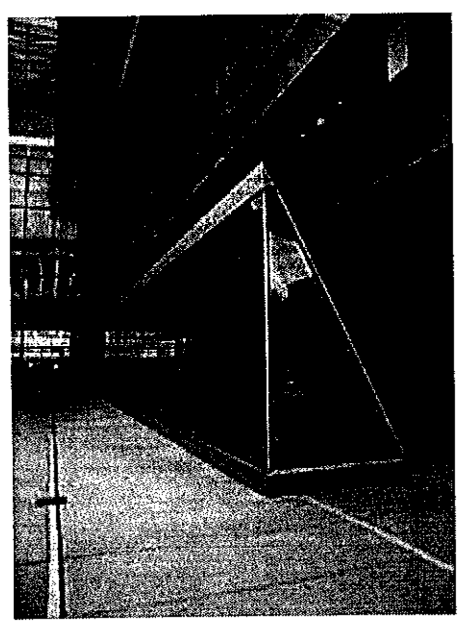
If a venting operation is going to be performed, it will require many firefighters, ideally under the supervision of a designated chief officer. Depending on the type of roofing material, you will need saws, axes, sledgehammers, prying tools, and pike poles to provide adequate ventilation. Firefighters will have to use a power saw in the near-vertical position to make cuts into the solid roof surface of the sawtooth. In this situation, they may have to be directed to adjust the saw blade guard prior to use to protect the operator from the roofing material being kicked up. If feasible, the firefighter making the openings should be backed up by a firefighter positioned directly to the rear. This will ensure the stability of the operator during cutting procedures.

The pattern of saw cuts should be similar to that made for peaked roofs. The initial opening will provide an indication of interior fire conditions. You then can expand this ventilation hole, if necessary, laterally along the length of the roof surface parallel to the ridge at both the top and bottom. If possible, make extension cuts with the wind at your back. You also may encounter roof ventilators, installed through the angled roof surface. You can remove these devices to expand the opening and help improve vertical ventilation.

(8) An inside view of the New York City Sanitation garage, which has a lightweight steel truss-supported roof monitor.

Reinforced concrete sawtooth roofs will provide a noncombustible platform for firefighters to work from but will generally limit vertical ventilation to removing glass and ventilators only. Roofing materials laid atop the reinforced concrete, however, may be combustible. They may include wood planking, membrane composites (rubber, plastics, and asphalt mixed with polymers), bituminous mixtures, metal, and insulation.

Sawtooths adjoining an exterior wall (glazing facing the exposure) pose an extreme life hazard to firefighters, especially at night or when smoke conditions hinder visibility. A firefighter walking up the solid roof side of the sawtooth is in danger of stepping onto and through the glass section of the roof into the building or rolling on the glazing off the roof and down to the ground.



(9) This innovative ground-level skylight supplies natural light to a

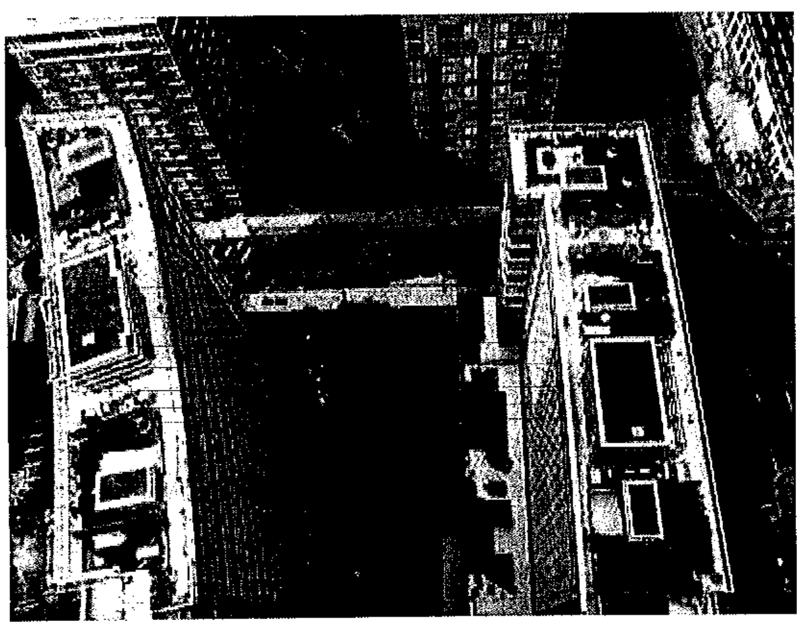
Bronx, NYC, below-grade
courtroom waiting area.

Chief officers must preplan buildings with sawtooth roofs. Critical information must be input into electronic databases for the benefit of all responding units. Include details regarding the roof's framing and construction, ventilation options, and unique hazards.

## Roof Monitors

A roof monitor is a raised section of a roof, usually straddling a ridge. It has openings, louvers, or vertical windows along both sides (primarily facing south or north) to admit light. Roof monitors may also be constructed with glazing on only one side. This structural configuration is known as a semi-monitor or half-monitor. Roof monitors provide uniform lighting throughout a space and eliminate contrast and glare. An additional daylighting function includes illumination of space along the perimeter of the building.

Often, roof monitors are supported by trusses. This condition negates cutting it to enhance vertical ventilation during fire operations. When fire is impinging on truss components, chief officers should ensure that all firefighters are off the roof, out of the building, and safely away from exterior walls, in anticipation of collapse. If construction type and fire conditions allow venting, however, open both sides of the roof monitor to ensure the maximum removal of smoke and toxic gases from the interior. Wind speed and direction may play an important role in how quickly the products of combustion leave the building.

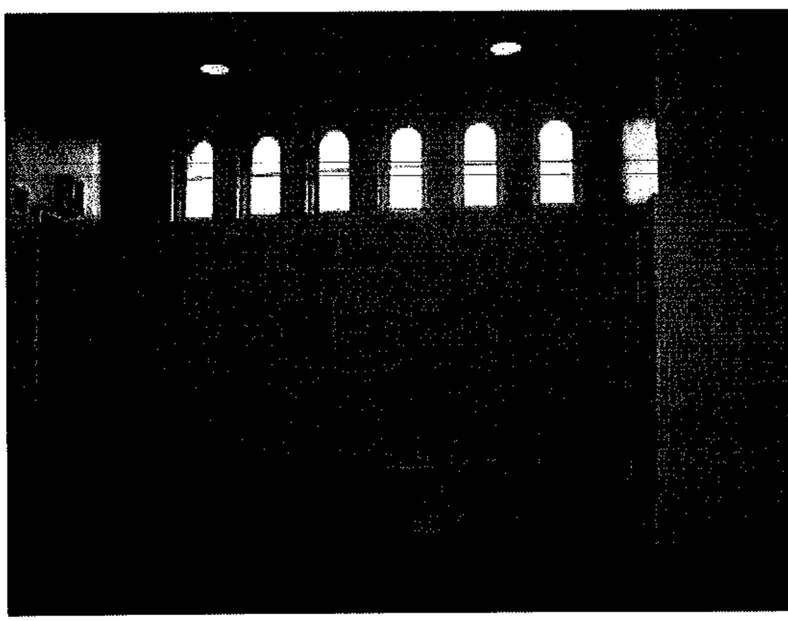


(10) This large exterior-type light court is at the rear of the three towers that make up this residential high-rise building.

The IC should evaluate the use of positive pressure ventilation (PPV) to facilitate hoseline advancement as well as the vertical movement of air out of the roof monitor as a tactical procedure. PPV can provide a tenable environment for interior operating forces to perform fire extinguishment, search and rescue, overhauling, and salvage operations. Commonly, an electric or fuel-driven fan is positioned outside the entrance (approximately four to 10 feet from the building), depending on the fan's diameter. It is placed so that an air cone is produced beyond the boundaries of the doorway. The roof monitor exhaust openings allow combustion by-products to escape as a result of the difference between the inside and outside air pressure. As smoke, heat, and gases are pushed out, ambient air is entrained into the building.

## Skylights

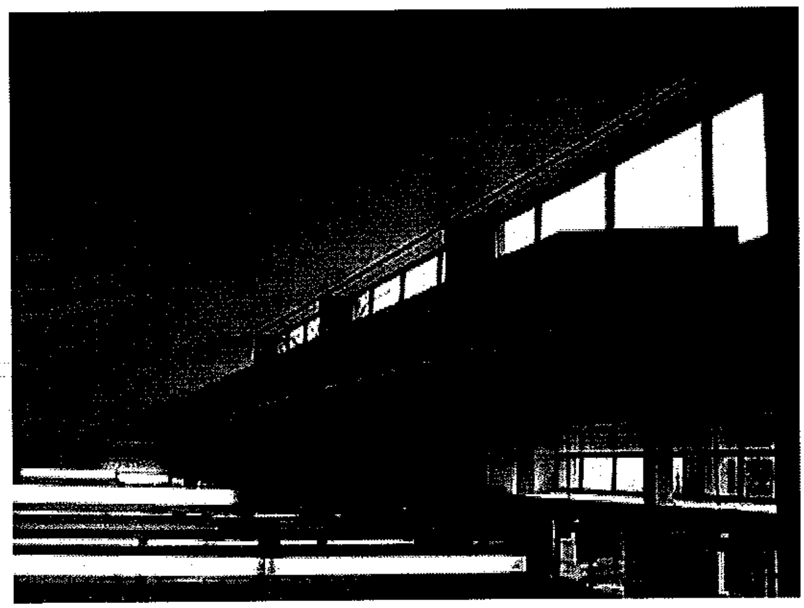
Skylights can span roof, staircase, shaft, as well as front and rear openings. These glass or translucent plastic daylighting components admit natural light to critical interior areas of a building. They have wide-ranging daylighting applications for all kinds of occupancies. Flat-roofed buildings generally have domed skylights. In many cases, the skylight functions as an operating window to provide a ventilation point as well as fresh air. Downward sloping skylights (glazing installed in a metal grid descending from the base of a second floor of a building to the front or rear wall) are used to provide natural lighting to the front or rear of large dimensional (factory, storage, and commercial) occupancies. Many of these skylights are covered over with roofing material for security reasons. These skylights generally span the entire width of the structure and allow for the use of space along the perimeter. Chief officers should consider having firefighters remove this covering to create critical ventilation points during stubborn first-floor and subgrade fires. Innovative skylights are now being installed at ground level to illuminate sublevel areas. Their removal will also improve interior conditions at hot, smoky below-grade fires.



(11) This row of clerestory windows provides natural light to this Cooper Union for the Advancement of Science and Art (East Village, New York City) classroom.

Building code requirements pertaining to a roof's fire resistance rating may require skylights to be protected (wired glass, for example) or limited in size. Chief officers should consider recommending the installation of fire retardant, polycarbonate panel roof skylights designed to melt away when subjected to fire, forming venting holes through which the products of combustion are released. This would facilitate vertical ventilation in structures that may prove difficult for firefighters to ventilate because of construction materials or a high-hazard occupancy type. When you have to ventilate domed Plexiglas® skylights, remove them from their frames, if possible. Generally, you can break skylights with wired glass glazing, however, since they are commonly sealed into the roof deck covering. Chief officers should encourage operating units to radio their intention of "taking" skylight glass to allow enough time for firefighters inside the building to retreat to a safe area. Additionally, firefighters should pause after breaking the first pane of glass before continuing, to let firefighters who did not hear the initial warning to move away from falling glass.

Building codes inadvertently, however, do not always have the firefighter's best interests at heart. An example of this is when thin fiberglass skylights inlaid flush with roofing material are allowed to be installed on a flat roof. Built without a raised frame or lip, these skylight panels do not have any load-bearing characteristics. They are also very difficult to see, especially when operating on a roof at night or under smoky fire conditions. In July 2009, a Newark (NJ) chief officer operating on an exposed corrugated metal roof at a nighttime fire stepped into an inlaid skylight under smoky conditions, falling more than 20 feet to a concrete floor below. The chief officer landed on his SCBA. Firefighters operating inside the building immediately located and removed the severely injured chief officer. He suffered multiple broken bones as well as damage to his spine. [See "Dangers of Fiberglass Roof Panels" (What We Learned, Fire Engineering, December 2009).]

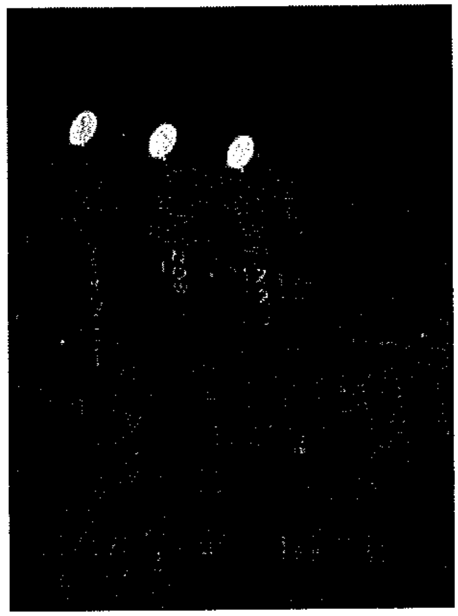


(12) Interior light shelves reflect sunlight from the glazing above onto the ceiling.

The timely removal of a skylight performed during fire operations can provide a tenable environment for occupants trapped inside the building. It can also prevent a backdraft or lessen its blast effects. Upward blast pressure will be released out the skylight opening, reducing the potential damage to the structural elements (walls and roof) of the building. Unfortunately, in many urban areas, skylights in nonresidential buildings have been removed and covered over with roofing material to prevent unlawful entry. This will delay and prolong both vertical and horizontal venting operations. Chief officers must evaluate this condition, as it will have important ramifications on firefighting operations and safety.

## Light Courts

A light court is a daylighting innovation used to provide illumination. The light court may sometimes use surrounding walls to reflect light over its area and can be open-ended (exterior type) or completely enclosed (interior type) and covered with skylights or uncovered. The light court may be designed as an occupied space where building occupants can gather or that can be used for daylighting purposes only. Found anywhere within the building footprint, light courts may also be inserted into corridors, providing various spatial changes as well as light and wind.



(13) Roof-mounted heliostats reflect sunlight to a neighboring residential building courtyard at ground level.

A fire in or entering a light court can spread throughout one or two buildings as flames and superheated gases make their way into exposed areas. Building codes limit the dimensions of exterior light courts built adjacent to neighboring buildings. Fire originating inside an occupancy facing an interior light court can spread by windows (autoexposure) to neighboring areas laterally and above. Chief officers must evaluate fire spread for both types of light courts when preplanning firefighting strategy and tactics. They should look to strengthen code requirements designed to protect areas having windows fronting on light courts. Installing window-opening protectors (fire shutters) would be one way to help alleviate the danger.

Large (wide), open-ended light courts tend to dissipate fire and the products of combustion more readily, providing greater safety to building occupants than small (narrow) enclosed light courts. Fire in or entering a light court may necessitate the stretching of multiple hoselines, which should be used to attack the fire's site of origin and potentially exposed areas. The overabundance of combustible materials (decking, furniture, benches, foliage, and so on) within a light court can facilitate heavy fire conditions.

(14) Synthetic windows along the base of a South of Houston Street (SOHO, NYC) building provide natural light to below-grade areas.

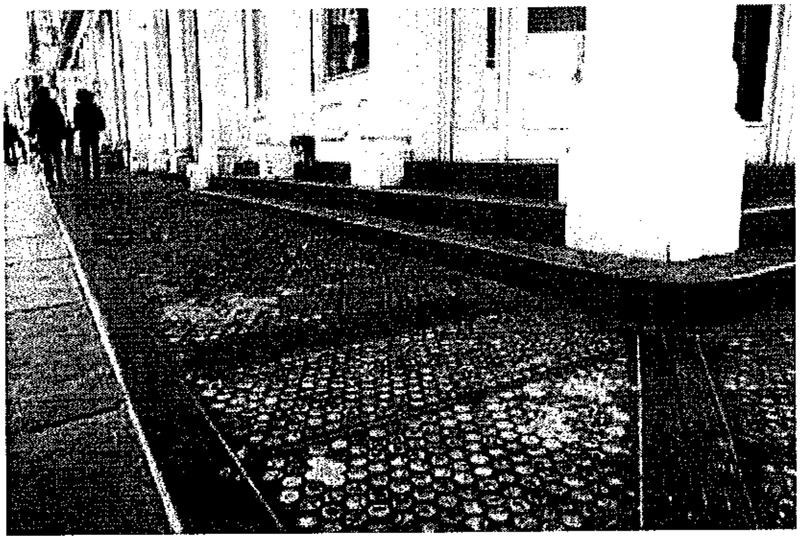
Heavy fire conditions inside a light court may necessitate using two hoselines (attack and backup) on the seat of the fire. Coordination and communication will help to avoid conflicting hoselines. Additional hoselines may be needed to extinguish fire that has spread to areas above. Ladder companies searching for life and fire inside a large, smoky light court may find team search techniques and search ropes extremely useful.

Chief officers must rely on firefighter reconnaissance to identify and describe the dimensions of light courts that have not been previously preplanned. Exterior positioned firefighters should be able to inform them of the size and shape of the light court—whether it is open ended or fully enclosed, whether it is covered or uncovered, and if the court services more than one building. Firefighters operating on the roof should be careful not to accidentally fall into the courtyard in smoky fire conditions. Firefighters operating inside the building should also be able to recognize and access light courts. Interior light courts are commonly accessed through doorways and passageways. They may be remote from the main entrance and have multiple access points.

## Clerestory Windows

Vertical glazing installed near the top of a wall is known as a clerestory window. This type of window allows light to penetrate more deeply into a room than windows of standard height. It delivers light high up in a room and illuminates the ceiling. Clerestory light is indirect, mimicking skylighting. Clerestory windows are normally found on the south or north face of a building, to allow light and shadow to play on adjacent walls and floors. This technique enhances a room's feeling of spaciousness. South-facing clerestory windows will have shades to prevent direct heat gain during the warm-weather months; north-facing windows are made of well-insulated glazing to prevent heat loss in the winter.

Clerestory windows are ideal horizontal vent points during fire operations. Be aware that natural ventilation in a structure will cause warmer air to rise into the upper levels. Pent-up gases and smoke from a fire will also accumulate in these areas. Firefighters venting clearstory windows will create a "stack effect," encouraging convective air movement and the products of combustion out of the building. Chief officers must ensure that firefighters do not use clerestory windows to enter a building for search and rescue. Generally, there is no landing directly under the windows for safe entry into the building. A firefighter entering a clerestory window could fall more than 10 feet down to the floor below and be seriously injured or killed.



(15) This metal sidewalk grating has inlaid deadlights.

From the exterior, portable ladders must be positioned to the sides of clerestory windows when firefighters are working off them during ventilation operations. This will provide a safe zone for heavy smoke and possibly fire to escape. Venting clerestories from the interior will commonly necessitate the use of longer than standard-size pike poles. During inspections, chiefs should have fire companies identify and record buildings having these windows for preplanning purposes.

## Light Shelves

Light shelves are reflective, horizontal surfaces that can be installed on both the exterior as well as in the interior of a building. They are commonly made of lightweight materials (metal alloys, aluminum composites, plastics) and have a shiny upper surface. Often, light shelves may extend from the exterior into the interior of a building. Located near the top of windows, they increase the useful range of perimeter daylighting by bouncing natural light up toward the ceiling, allowing light rays to reflect down more deeply into the interior of a room. In the Northern Hemisphere, light shelves are usually placed along the southern perimeter of a building, to catch the most sunlight. This is reversed in the Southern Hemisphere.

Each internal light shelf is mounted on a wall approximately seven feet high for safety reasons and to prevent glare from reflecting into occupants' eyes. Some light shelves, however, are strategically placed along internal walls or partitions at lower heights. It is particularly important for safety chiefs to know where they are, as they could cause trauma injury during firefighting operations. Light shelves located outside the building are commonly installed above window openings attached to exterior walls. In addition to allowing light to penetrate through the structure, light shelves also provide shade near the windows because of the shelf's overhang. This helps to reduce window glare. Exterior shelves are generally more effective shading devices than interior shelves.

Exterior light shelves protrude several feet from the wall. This can interfere with ladder positioning, roof/window access, search and rescue, and ventilation operations on the fireground. During construction or renovation, chief officers should be included in the decision-making process regarding how many and where they should be installed. Chief officers must stress the need for access points along exterior walls where light shelves will be excluded. Interior shelves can pose similar problems for the fire service.

## Heliostats

Heliostats or solar mirrors may be installed on the roof of a structure or around a building's perimeter. A heliostat calculates the movement of the sun by way of a computer and moves its reflector to deflect sunlight onto one or more fixed areas inside a building or on an outside area (park, courtyard, or garden). Besides light, heliostats also reflect thermal heat energy for interior climate control and water heating. Heliostats are commonly used to enhance lighting inside buildings by directing sunlight through a window toward a room ceiling. The light then diffuses off the ceiling to illuminate the interior. These devices are also employed on sunny days in place of space heaters to supplement home-heating systems. Ancillary components allow for thermal storage capabilities.

When installed on a roof and depending on their number, size, and weight, heliostats present an additional load for the roof to support. This is never a good thing, especially during a fire when flames are weakening the roof's structural members. They will also represent yet another obstacle and tripping hazard for firefighters to avoid when performing their operational duties atop a building. Small-sized heliostats can be hidden from view during nighttime hours, fog conditions, and heavy snowfalls, making them an invisible impediment for the firefighter. Consider all heliostats unstable. Do not use them as a substantial object during life safety operations using ropes. Heliostats may determine where ladders should be positioned at the roof. On a sunny day, for example, don't place the tip of a ladder directly in line with a heliostat, which could cause a firefighter accessing the roof to be blinded by the glaring light being reflected off it. This could cause the firefighter to lose his equilibrium and fall backwards off the ladder.

Heliostats installed at ground level can also have a negative effect on firefighting operations. They can hinder the positioning of portable ladders if they are placed too close to the perimeter of the structure. Light reflected by them through windows could, if not properly directed, throw disturbing light into the eyes of firefighters operating inside. Chief officers should be on a constant lookout for abnormally shaped equipment on rooftops and the surrounding property of buildings. Examine them for functionality and purpose.

## Synthetic Wall Windows

Synthetic walls are horizontal, nonoperable, rectangular- or square-shaped windows located along street façades of buildings. They provide natural light to display areas at the ground floor for commercial occupancies or sublevel areas. Over the years, however, many synthetic walls have had their glass removed and covered with cast-iron plating, masonry, metal grilling, or plywood for security reasons.

Removing the glazing/covering from a synthetic wall that services sublevel areas can provide an opening for entry/egress as well as ventilation. Synthetic walls may also be large enough for exterior hose stream, foam generator, cellar pipe, or distributor application. These openings will facilitate the use of PPV fans or smoke ejectors to push fresh air into sublevel areas or remove the products of combustion, respectively. Synthetic wall glass at display window levels can be removed and the openings expanded to enhance ventilation at the ground floor.

During nonfire incidents, when faced with high-security entrance doors and barred/blocked-up windows, chief officers should also consider synthetic wall openings as a viable way to view/access the building with minimal damage.

### Deadlights

A deadlight is translucent glazing that comes in oval, rectangular, or square shapes. Deadlights are supported by a metal grid making up an entrance stair or sidewalk grating or inlaid directly into the surface of a concrete/granite sidewalk. Deadlights have been used for centuries to illuminate sublevel areas below ground and sidewalk vaults (three-wall enclosures below grade extending beyond the front of a building). These vaults can continue downward to all the sublevels of a building and may extend the full width of the sidewalk.

Chief officers must train drivers of fire service apparatus to be especially careful not to position their vehicles onto sidewalk areas when deadlights are present or where they have been removed and replaced with diamond plating. Improper apparatus positioning and tormentor placement at fire operations have collapsed these areas. Fire service and civilian vehicles have fallen through sidewalks having deadlights, striking structural elements supporting sublevel areas, leading to a major building collapse. Chief officers should demand that requirements be established for placing hazard warnings conspicuously on the exterior of buildings, warning motorists of this potential danger.

Over the years, because of damage and disrepair, the deadlights in many cases have been removed and replaced with granite, stone, concrete, or diamond plate. Today, as a result of renewed enthusiasm in daylighting design, deadlights are making a comeback. The natural light entrained into basements and cellars by deadlights have made these areas usable for residential and commercial purposes.

Removing deadlights or the metal frame above a sublevel area or sidewalk vault requires forcible entry tools, mauls, pneumatic jackhammers, and specialized equipment. This can provide critical vertical ventilation at stubborn cellar and subcellar fires as well as create ideal insertion points for cellar pipes, distributors, and foam generators. For sublevel fires, it may be necessary to place portable ladders down into these areas for firefighter access and egress. Chief officers should consider special-calling additional rescue or squad companies for their expertise and compatible tools needed to perform this work.

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Daylighting encompasses many innovative design concepts, novel construction practices, and efficient illumination devices. It is a popular component of green building construction and is being used at a growing rate in all types of structures and occupancies. This article deals with just a few daylighting features that I have encountered during fire operations and inspections. A working knowledge of daylighting is vital not only for your safety but also for the public's well-being. Daylighting techniques may have already been incorporated inside your own quarters! Chief officers must keep their eyes open and plan firefighting strategy and tactics accordingly.

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**RONALD R. SPADAFORA** is a 32-year veteran of the Fire Department of New York and is an assistant chief. He is an adjunct professor of fire science in the Department of Protection Management at John Jay College (CUNY) and a senior instructor for Fire Technology Incorporated. He is an editor and frequent contributor to FDNY's *WNYF* magazine.

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