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Publisher's version / Version de l'éditeur:

Specifying Engineer, 43, 5, pp. 93-96, 1980-05

NRC Publications Record / Notice d'Archives des publications de CNRC:
https://nrc-publications.canada.ca/eng/view/object/?id=a67683d5-9273-4413-8d6e-d338f32606f2
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SORTING OUT FIRE EXIT VS BUILDING SECURITY NEEDS

By Byron M. Johnson

Reprinted from
Specifying Engineer
Vol. 43, No. 5, May, 1980
p. 93-96

DBR Paper No. 975
Division of Building Research

Price $1.00 OTTAWA NRCC 19397

SOMMAIRE

L'auteur présente les techniques de sécurité contre les intrusions et les techniques de sécurité contre l'incendie dans les bâtiments en insistant sur les cas d'objectifs contradictoires. Il indique une méthode d'analyse des relations gestion-occupation et de la conception du bâtiment propre à réduire les contradictions dans la plupart des cas.

Sorting out fire exit vs building security needs

The author unravels the conflicts which occur when making tradeoffs between building security and fire safety

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☐ Individuals concerned with fire safety want as many exits as are economically possible; those concerned with security want as few as possible. Both groups have compromised, especially security personnel, despite increasing life and property losses resulting from crime in recent years.

At present, fire and crime result in property losses and personal injuries of equal magnitude. Specialists in security, building design, building management and sociology have discussed the importance of building design in relation to this problem at the Division of Building Research, National Research Council of Canada. They concluded that relatively simple modifications to building design and the specification of better hardware and construction would greatly reduce crime, without jeopardizing fire safety.

To provide measures that are sufficient to deter a potential intruder without being too elaborate or too expensive, involves an assessment of the risk to the building, its contents and the occupants. Among the factors that determine the risk of criminal attack are location of the building, value of contents, and type of building. These are described in "Patterns of Burglary," H.A. Scarr, U.S. Government Printing Office, Washington, D.C., 1973. Consideration must be given not only to the costs of building repairs or replacing valuables but also to those resulting from personal injury, legal proceedings and the wider social costs of support for convicted criminals and their families. Compared with these, the additional cost of providing adequate protection to most buildings is negligible (Johnson, B.M., Crime Prevention Through Building Design, *Specification Associate,* Vol. 20, No. 1, January/February 1978).

About the author

Byron M. Johnson, B.Sc. in Mathematics (University of Victoria), B.Sc. in Architecture (University of Edinburgh), joined the Division of Building Research, National Research Council of Canada, in 1975. His main interests at DBR have been the requirements of building occupancies, in particular the movement of people within buildings and the design of buildings for easy use by the handicapped. A recent outgrowth of these interests is the study of crime prevention through building design.

Non-residential buildings

In non-residential occupancies, the resolution of the conflicts between building security and fire safety requires understanding of the needs of the occupants and method of operation of the building.

Over the past five years DBR/NRC has investigated the movement of spectators in theatres, arenas, and grandstands. These studies were concerned with evacuation time and safety and identifying security procedures that affected evacuation. Such procedures were most apparent at the Olympic Games in Montreal where all exits were constantly surveyed and complex arrangements made for the protection of dignitaries.

Places of assembly are usually concerned with preventing unpaid entry, either by guarding the exits or locking them during performances. Guards, however, are expensive because of the number required. Even where exits are close together at least one guard may be required at each door. In one Canadian arena two guards are needed for hockey games and rock concerts to prevent groups of spectators inside from assaulting solitary guards and letting friends in.

Where regulations permit, exit doors can be locked either by manual latches or solenoid holders. The solenoids have the obvious advantage of allowing rapid release from a central control, overcoming many of the problems associated with manual latches; but they need to meet strict (in many cases impossible) regulations to prevent electric shock or failure to function. In addition, a manual lock must be installed to ensure that doors remain locked during power failures.

Several factors have contributed to the rising rate of theft from office buildings. Increased area and open working arrangements make it possible for strangers to walk unchallenged through work areas, steal an article and escape by way of exit stairs. Calculators, electric typewriters, and specialty equipment are prime targets. Very often security systems have been designed to prevent illegal entry for the purpose of industrial espionage or similar crime, but petty theft is a greater problem, possibly of the order of $75,000 for every ten stories of office space (10,000 sq meters) every year. In Canada, as elsewhere, government agencies require provisions for security in the design of all new buildings, (Building Security, Public Works Canada, August 1975, Briefing Document D-9).

Losses of $75,000 a year for every 10,000 sq ft of office space makes petty theft more than just petty

The main problem with offices results from the ease of movement between floors via stairs or elevators, particularly after hours. The importance of control at elevator lobbies has long been recognized and specific recommendations have been made. Entry to the offices can be controlled by a simple installation of a contact switch that sounds a buzzer when a person opens the door from the lobby. It is suggested that passage via elevators should be made more difficult by enclosing and locking each elevator lobby when no one is working on the floor. An exit stair off the elevator lobby would be required, and it could be designed for smoke pressurization to provide temporary refuge in the event of fire for anyone having difficulty using the stairs.

Most building regulations require at least one exit stair directly to the outside and this makes it difficult to prevent "grab-and-run" techniques. This direct exit is required for its assumed usefulness in evacuations, but research has revealed that during evacuations 40 percent more

TABLE 1—REQUIREMENTS FOR EXIT-DOOR DESIGN

Type of exit	*Type of occupant Responsible*	*Hostile*	*Security conscious*
Open exits	• Door needs surveillance but entry/exit is uncontrolled • May be required for evacuation of crowds • Hardware should give good "silent-hour" security	• Easily opened in confirmed emergency but otherwise controlled • Hardware should give good security when building unoccupied	• Usually needs to be controlled • Method of detecting "unwanted" visitors may be required • May require 24-hour "guarding" or alarm
Enclosed exits	• Surveyed or set with alarms that allow adequate response • No exterior hardware • In some locations may be locked unless confirmed emergency	• Surveillance required when building occupied • Easily inspected from outside, should be very secure	• Alarm on exit is needed • Possible surveillance by cameras
Special exits	• Should be controlled when building occupied and locked or isolated when unoccupied	• Isolated from main building unless controlled • Secure hardware, possible alarms	• To be avoided unless doors are locked by remote control

people, on average, use the stair that terminates in the main lobby than the stair that does not.

There are several possible explanations for this, but the main one is familiarity. This conclusion is reinforced by other studies, such as "Pilot Study on Personnel Movement in Office Buildings, Health Impacts of the Use, Evaluation and Design of Stairways in Office Buildings," Johnson, B.M. and Pauls, J.L., Health and Welfare Canada, April 1977. Pauls recommends that the lobby stair be designed to encourage normal use as well as efficiency during evacuations. In buildings with central service-cores, exit stairs often pass through the basement if they do not terminate at the lobby. As fires frequently start in the service area beneath the lobby level, it is worth re-examining requirements that result in exits through basements.

One solution for such stairs would be to construct an emergency door in the stairwell at lobby level that, if opened, would activate an alarm to give security personnel sufficient time to apprehend the thief. Such a door and wall could also reduce smoke movement. Alternatively, if all stairs and elevators from upper stories terminate in the main lobby, then everyone would pass security personnel either to exit directly outside or indirectly through parking or service areas.

Non-emergency use of exit-ways results in the common problem of exit-doors being held open, allowing smoke movement in the event of fire. Although this problem is not related to security, it emphasizes the importance of understanding and planning for the desired traffic patterns in buildings. This means that integration of fire emergency systems and security systems is essential, as advocated by Fitzpatrick and Ruchelman: "Rather than operating as separate activities, the two functions must be seen as comprising a total security package for high-rise buildings" ("Integrated Fire and Crimé Systems in High-Rise Office Buildings," *Skyscraper Management,* July 1974). A school is an example of a building type where the complexity of the activity patterns creates problems. Night-time use presents significant problems of vandalism even where schools are used only by adults in the evening. This raises the issue of master keying and a mechanism for key control. As with office buildings, there is value in analyzing activities and zoning the building so that everyone does not have free access after hours when few supervisory staff are present. Zeisel has made recommendations on design and hardware selection that allow designers to produce good buildings with proper consideration given to the occupancy patterns of the schools ("Stopping School Property Damage," American Association of School Administrators, 1976). In correctional institutions the conflict between security and evacuation needs is obvious.

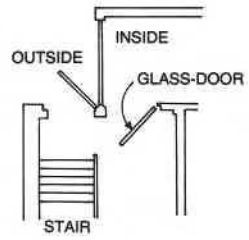
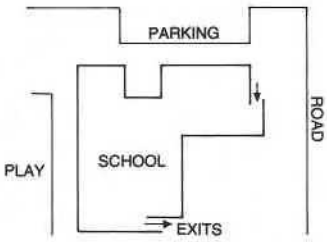
One of the considerations is whether the occupants will aid or prevent a crime

Standards have been developed in the U.S.A. to deter the use of windows as a point of entry in all types of buildings. Windows are frequently broken by vandals and can be lifted out of their mountings either by prying or unscrewing. They can be secured by stronger frames, non-retractable screws on the outside, or by pins through the frame and mullion. These pins should be designed to be easily removed for windows that might be used as emergency exits. Basement windows are the most difficult to force open; sash and pivot hung windows are easier to force open, sliding windows generally provide little security. Sliding patio doors can be secured by placing screws in the top track to prevent the window or door being raised. Laying a rectangular wood board in the lower track will stop forcible sliding; round sections can be rolled out of place.

The use of plastic glazing can serve to stop vandalism to inaccessible windows, but in high risk buildings such as schools, such material is easily marred. Windows should be protected by meshing in such locations. Expanded metal of similar size as ornamental leaden windows can be used to make illegal entry difficult. In general, bars or meshings should be positioned on the inside of the windows.

TABLE 2—REQUIREMENTS OF SERVICE DOORS FOR A HIGH SCHOOL

Context of pattern: Emergency Exit-Door From Stairs

Requirements	Recommendations	Patterns
Surveillance required when building occupied	Glass doors to stairwell to allow doors to be seen	
	Alarm on opening	
Easily viewed from outside	Position facing road	
Very secure, class III NILECJ	Firm frames	
	No exterior hardware	

Security hardware

There are two basic types of security hardware: passive and active. The first attempts to delay or discourage an intruder by presenting obstacles. Active hardware announces an intrusion or retaliates. This type is often advocated, however, without adequate recognition of the inherent difficulties. Many types of active hardware, such as electric fences, can be dangerous and may make a building owner liable to an extent greater than his potential loss would justify.

Alarm systems depend on having someone to react quickly. They are frequently installed on exit doors to deter thieves from grab-and-run techniques. Although no definitive studies have been done, it seems probable that in most cases these installations are ineffective. Security personnel can seldom react fast enough to reach an exit in time to apprehend the culprit. The same seems true of preventing illegal entry. By the time security personnel can reach the door there will probably be no sign of the intruder, and it is uncertain whether the alarm was activated as a result of malfunction or hard knocking. Video cameras can be useful for observing an entrance when an alarm sounds, but are very expensive and would be warranted where the risk is very great.

Passive hardware may also present difficulties. For exit doors the required panic bar is most unsuitable for security. Tests have shown that it is easily cheated unless special door frames are installed and, if used frequently, it breaks down because people often exert force on the door before the bolt can retract.

Type of occupants

Hostile Occupants: Despite the emotive strength of this term, there are many occupancies where the occupants would not try to prevent a crime. The inmates of correctional institutions are, in general, hostile to management or administration. Less obviously hostile are those who use public assembly buildings, yet seldom will a visitor or spectator try to prevent a criminal action. Other occupancies such as schools and universities are subject to circumstance. As a general rule, the determining factor is whether occupants would be expected to prevent or aid a crime. In most instances hostile occupancies require some security staff to protect either the building or its occupants from other occupants. If either illegal entry or exit is the main security problem, then large numbers of security staff may be needed.

Main entrances are often the least vulnerable when compared to other exits

Responsible Occupants: Occupants of this type would in the majority of cases be held responsible if they did not sound the alarm or question doubtful behavior. Most office buildings fall marginally into this category. Generally, the number of security personnel is few and the occupants are implicitly expected to perform this function, although they have not been given clear directives or training.

Security Conscious Occupants: Few buildings have occupants trained to take definite action toward someone committing a crime. Military establishments and similar occupancies are of this type, but they face little risk of the type of crime that can be prevented by environmental design. Other occupancies where people perceive intervention to be in their interest might include airports, owing to the common fear or terrorist action, or banks where fear of financial loss might prevail.

Types of exits

The categories first described help to define how occupants use entrances and exits of buildings and their attitude toward them. Frequent use of an exit door and failure to ensure that it is properly closed can allow an intruder to enter illegally. This often happens in office or apartment buildings where considerable caution is, at the same time, being taken to ensure that garage or main entrance doors are kept locked. The problem of exit doors requires a classification scheme for the topology of exit doors.

Open Exits: These are generally the main or front entrances of buildings. They are locked or unlocked according to the amount of supervision available and the

general level of security. They can often be observed from a desk or from the road (i.e., from patrol cars). Ironically, these doors have received the greatest attention for security, yet they are probably the least vulnerable. One problem concerns the requirement for determining who should be allowed to enter, one of the unresolved problems in crime prevention. In many instances front entrances may need to be only class I or class II, according to the classification system of the National Institute of Law Enforcement and Criminal Justice (NILECJ).

Enclosed Exits: Most buildings contain several exit stairs that are completely enclosed and exit directly to the outside. They can only be surveyed by cameras, prohibited for normal use, or given special security treatment. There are many problems with such exits: easy escape for thieves, occupants using the stair to travel to prohibited floors or to avoid being questioned by receptionists, occupants using the exit on a day-to-day basis (thereby wearing out hardware that later allows entrance to unauthorized persons), and persons who cheat the exit door from the outside. This last problem of unauthorized entry concerns both door manufacturers (i.e., to produce hardware that cannot be defeated easily) and designers of security systems in trying to design a system that reacts quickly to illegal intrusion. These exits should be at least class III of the NILECJ classification system, but if there is no external hardware they can easily be built to class IV.

Special Exits: Special exits are those at which users can expect to be challenged, for example, exits from workrooms, basements, or perhaps such facilities as freight doors. Use of such exits would require good knowledge of the building. Generally they share the problems of enclosed exits, but have the advantage of being isolated when the building is unoccupied and perhaps even when it is occupied. Exits in this category can easily be determined by considering the level of risk and the occupant/management relation.

Exit door requirements

If an analysis is undertaken of occupancy/management relations and the topology of exit doors, the requirements given in Table 1 can be used to develop specific design recommendations for individual buildings. A series of patterns can be drawn and taken by the designer to produce hardline drawings. This technique of pattern drawing was strongly advocated by Alexander in "Notes on the Synthesis of Form," Harvard University Press, Cambridge, Mass., 1967, as a method of expressing requirements.

The use of patterns of requirements is shown in Table 2 for a hypothetical high school. Several topologies and functions of exits are analyzed. The occupancy/management relation is considered hostile, primarily because of the number of students with this attitude. The main concern, however, is illegal entry plus theft or vandalism rather than illegal entry alone (e.g., at dances) or uncontrolled escape during school hours. It is further assumed that the school is used in the evening despite the management problems this creates.

In the development of these patterns the NILECJ classification system was used for describing the level of resistance of the doors. It has the advantage of ready use in producing a specific statement of what should become established tests on doors. To some extent, however, it must be admitted that the classification system did not relate well to the problems of the types of door in the example chosen, primarily because of its apparent orientation to domestic situations. □