



National Institute of Justice

Research in Brief

Jeremy Travis, Director

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Issues and Findings

Discussed in this Research in

Brief: How Crime Prevention Through Environmental Design (CPTED) concepts can be applied to parking facilities along with active security measures such as guards and emergency communication systems.

Key issues: Because parking facilities comprise a large volume of space with relatively low levels of activity, violent crime is more likely to occur in a parking facility than in other commercial facilities.

- Many parking facilities lack CPTED design features because most property owners and architects are not familiar with basic principles of design concepts for crime prevention.

- Zoning ordinances and building codes can sometimes hinder effective use of CPTED principles. Examples include requiring landscaping to screen parking facilities, placing height limits on light poles, and mandating enclosure of exit stairs.

- Although CPTED principles can be readily incorporated into parking facilities at design and construction stages, it is often difficult and expensive to upgrade security at a later date.

Key findings: Municipal governments can have a major influence on building design, and local officials can play a much stronger role in fostering security planning.

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Crime Prevention Through Environmental Design in Parking Facilities

by Mary S. Smith

Because parking facilities are more likely settings for crime—both violent and property—than all other real estate except residential, security is one of the most critical issues facing the owners and operators of parking facilities today. Local government officials are also concerned about the security of these facilities—some of which are city owned or operated—because parking affects the economic viability of a community.

Crime Prevention Through Environmental Design (CPTED), which emphasizes the proper design and effective use of a created environment to reduce crime and enhance the quality of life, is particularly applicable to parking facilities. Incorporating CPTED can significantly reduce the fear and risk of crime as well as the considerable costs associated with hiring security personnel.

This Research in Brief offers an overview of up-to-date design concepts for parking facility security measures and other possible security and existing parking facility ordinances. The framework and rationale for a flexible plan to improve parking lot security is described.

Crime in parking facilities

Because parking facilities comprise a large area with relatively low levels of

activity, violent crime is more likely to occur in a parking facility than in other commercial facilities. A typical suburban shopping center requires 1.5 square feet of parking space for every square foot of leasable retail space; office buildings generally need at least 1 square foot of parking space for every square foot of office space.

Therefore, a shopping center that consists of 1 million square feet will probably have 1.5 million square feet of parking. More than 10,000 people may be at a mall during the peak hours of a busy shopping day; however, only a small fraction will be in the parking lot, which is 1.5 times as large as the mall. This fact increases the likelihood that an individual can be isolated in a parking area and targeted for an attack, which, in turn, attracts people with criminal intent (see “How Safe Are Parking Facilities?”).

Other features that make security difficult are simply inherent to parking facilities:

- Parked cars provide hiding places and impede the distribution of lighting.
- Most parking facilities are open to the public.
- An offender’s car is not likely to be noted as strange or memorable in a public parking facility.

Issues and Findings

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- The single most important CPTED security feature is lighting. Lighting codes should meet the standards of the Illuminating Engineering Society of North America.
- Elevator lobbies and stairs in open parking garages should be open to the parking areas except at roof levels where glass enclosures may be provided for weather protection.
- Where possible, elevators and stairs should be located on the perimeter to permit natural surveillance from exterior public areas via glass-back elevators and glass at stairs and elevator lobbies.
- Access control and perimeter security should always be considered in the initial design stage. Even if the potential site for the parking facility is low risk, the risk level could change in the future.
- Emergency communications such as panic buttons and closed circuit television cannot compensate for a lack of CPTED; however, they can enhance CPTED in high-risk facilities, and all facilities should be designed so such enhancements can be easily installed.

Officials framing a municipal ordinance to mandate security features in parking facilities should consider requiring facilities to regularly submit an updated management plan that responds to the particular needs of a facility. The plan should include a risk audit and proposed CPTED and active security measures, such as emergency communications.

Target audience: municipal government officials, building owners and managers, urban planners, architects, and criminal justice professionals.

Another factor that contributes to the problem of security in parking facilities is the increasing preference for parking garages over parking lots. Land is often too valuable, especially in urban areas, to devote to acres of surface parking; therefore, multilevel parking garages are often built to accommodate the increasing numbers of cars on the road (see “On the Road Again”).

Parking garages, which are either partially or fully enclosed and elevated above grade, offer much less natural surveillance—a primary focus of CPTED—than an open single-level parking lot of the same capacity. Surveillance within an enclosed facility may be further constrained by sloping ramps on multiple floors, which are necessary to provide floor-to-floor circulation.

Security in all types of parking facilities has tended to be reactive rather than proactive and often is addressed only af-

ter an incident has occurred. Although it is relatively easy and inexpensive to incorporate CPTED concepts in parking facilities at the time of construction, it is often difficult and expensive to upgrade security at a later date, especially in parking garages that may have inherent design features that inhibit security.

CPTED and active security strategies

CPTED is particularly applicable to parking facility design because its principles of natural surveillance, access control, and territoriality (i.e., sense of control over an environment) all have roles in preventing crime in a parking facility.

Security design involves selecting the right building features, materials, and systems to meet established *passive security* and *active security* requirements.

A How Safe Are Parking Facilities?

Although there are no exact statistics available, a conservative appraisal based on national transportation data¹ estimates that nonresidential parking facilities are used 175 million times every day. Because an individual must walk through a parking facility twice, this number results in 350 million pedestrian trips through parking facilities each day.

In 1992, parking facilities represented the third most frequent place in which violent crime (e.g., rape, robbery, assault) occurred, averaging about 1,400 violent crimes per day.² Therefore, it appears that the risk of being attacked in a parking facility, 4 in 1 million, is really quite low. Inter-

estingly, about 20 percent³ of violent crime in parking facilities is committed by persons known to the victim.

Even though one-third of all violent crime occurs in residential settings, and a little over 24 percent occurs on non-residential streets,⁴ the average American believes that walking through a parking facility is less safe than walking down the street in his or her own neighborhood. Television shows and theatrical films often feature attack scenes in parking garages, and press coverage of actual incidents often adds to the perception that these facilities are unsafe.

A On the Road Again

According to the 1990 National Personal Transportation Survey (NPTS), Americans average 1,042 personal trips per year (including commuting), or 2.85 trips per day. This figure does not include trips made on business, such as crosstown trips made in automobiles that are parked at the point of destination. NPTS also found that fewer than one-half of personal trips between 6 a.m. and 9 a.m. were journey-to-work trips. Additional relevant statistics from the 1990 Census indicate there were 115 million working adults and 165 million registered drivers. From 1960 to 1990, the percentage of workers commuting by private automobile increased from 70 percent to 88 percent. Another 5 percent used transit systems, but most of these public transportation users drove to and parked in commuter parking facilities.

Passive security refers to physical design features such as lighting. All passive security measures essentially incorporate CPTED concepts. Active security refers to human activities that may or may not involve specialized equipment, such as security patrols, intercoms, and monitored closed circuit television (CCTV) systems.

Even though consultants who specialize in parking design have espoused the use of CPTED for almost 20 years, it has not yet taken hold in the industry. In 1979, the first edition of *The Dimensions of Parking*, published by the Urban Land Institute and authored by the Parking Consultants Council (PCC) of the National Parking Association (NPA), devoted an entire chapter to security design, most of which conforms to today's concept of CPTED.

Why then are so many parking facilities designed with little or no attention

to security? Basically because most property owners and architects are not familiar with the basic principles of CPTED. Very little time is devoted to parking designs in typical architectural education programs, and assignments for such projects are often relegated to the most inexperienced members of architectural teams. As a result, active security systems are often needed to correct problems created by architectural designs that failed to incorporate CPTED.

Specific CPTED concepts for parking facilities

The following sections describe specific CPTED design concepts in these areas: lighting, natural surveillance, stairtowers and elevators, access control, signs and graphics, and restrooms.

Lighting

Lighting is universally considered to be the most important security feature in a parking facility. Good lighting deters crime and produces a more secure atmosphere. It is one of the few facility features that has been documented to reduce crime in parking facilities.

Two case studies⁵ found that prior to the installation of a parking lot lighting system, the Fairmount Fair Mall in Camillus, New York, was experiencing a high level of car break-ins. The installation of a lighting system eliminated these break-ins, boosted mall patronage, and allowed the scope and frequency of security patrols to be reduced.

Similarly, the installation of an effective lighting system at the parking lot in Spring Valley Park in San Diego, California, eliminated robberies, vandalism, and burglaries. Vehicular accidents were also reduced, and children and the elderly began to use the park at night once again.

Although it is beyond the scope of this article to discuss all aspects of lighting design, a few basic principles should be mentioned to illustrate how lighting design relates to security.

Illuminance. Illuminance is the intensity of light falling on a surface, measured in footcandles (English units) or lux (metric units). Illumination levels are different not only on horizontal planes, which are at different distances from the light source, but also at various angles. If you hold a light meter horizontally at any point, it usually gives a different reading than if you hold it vertically. Horizontal illuminance (i.e., illuminance of the horizontal plane) does little to aid in the visibility of vertical objects such as signs and keyholes. Therefore, vertical illuminance is an equally important consideration in parking facility lighting.

Uniformity. Uniformity is critical. Passing from light to dark areas creates problems for drivers because of the eye's inability to adjust rapidly. It is also imperative to get light into the edges of parking stalls rather than just into driving aisles. Maintaining an appropriate uniformity ratio avoids these problems. The uniformity ratio is expressed as either the maximum or average illuminance divided by the minimum illuminance. For example, if the average to minimum ratio is 3:1 and an average illuminance of 6 footcandles is desired, the minimum illuminance at any one point must be 2 footcandles.

Glare. Another important lighting consideration is glare. Glare reduces the contrast of an object against its background,⁶ making it difficult for the eye to perceive depth accurately. Glare is a potential hazard for all drivers but is particularly dangerous for senior citi-

zens and other individuals with weak or impaired vision.

There is a fundamental conflict between obtaining vertical illuminance and eliminating glare. However, glare can be minimized by the careful selection and positioning of fixtures. For example, lights can be positioned over parked vehicles rather than in the center of drive aisles. In addition, with one-way traffic patterns, lights can be positioned near beams—using the latter as shields to reduce the glare that is created by approach angles. Some manufacturers of light fixtures now include built-in shields that reduce glare while providing some up-light for vertical illuminance.

Industry standards. The Illuminating Engineering Society of North America (IESNA) Subcommittee on Off-Roadway Facilities⁷ sets what is generally considered the minimum standard for lighting design in parking facilities. However, the current IESNA recommendation for vertical illuminance is a subject of some controversy in the industry. Because the standard is virtually impossible to achieve in most parking facility designs, many designers have chosen to disregard it entirely. At the time of this writing, the IESNA subcommittee is revising its guidelines. New guidelines should be published by the end of 1996, and some change in the vertical illuminance standard is expected. The PCC of the NPA has also recommended guidelines, which are somewhat different from IESNA's (see table 1).

The most basic of these lighting requirements are often not met, even in new parking structures. One of the leading experts in parking structure lighting in the United States has noted that the top three and most critical

Table 1: Industry Standards for Lighting Levels

	Horizontal Illumination (footcandles)	
	NPA ¹¹ (a)	IESNA ¹² (b)
Covered parking areas		(c)
General parking areas	6	5
Minimum at bumper walls	2	1.25
Ramps and corners	—	10
Vehicle entrance	40	50
Vehicle exit	20	—
Stairwells, exit lobbies	20	10/15/20 (d)
Roof and surface parking		(d, e)
General parking areas	2	.8/2.4/3.6
Vehicle ramps	—	0.5/1/2

^a Minimum 30 in. above floor; uniformity ratio (average to minimum) 3:1.

^b Average on pavement; uniformity ratio 4:1.

^c Daytime only; 5 footcandles at night.

^d Average footcandles for low/medium/high activity areas; converted from minimums using uniformity ratio of 4:1.

^e Average vertical illuminance shall be 5 footcandles measured at 6 ft. above the pavement.

mistakes in lighting design are (1) lack of understanding of industry standards, (2) inadequate vertical illuminance, and (3) poor lighting uniformity.⁸

Level of service. Although security in all parking facilities would be measurably enhanced if it met IESNA standards, higher risk facilities ought to have even higher security standards. According to published IESNA standards, "These lighting levels are the lowest acceptable levels, consistent with the seeing task involved and the need to deter vandalism while at the same time meeting energy constraints."

Today, many owners of parking facilities are requiring higher lighting levels. The level of service (LOS) approach developed by the author for many different parking design criteria⁹ may be useful in selecting the desired level of lighting. Borrowed from the traffic engineering profession, the LOS approach is familiar to parking facility owners, city officials, and architects alike. Each

LOS is represented by a grade: LOS A is a superior design, LOS B is above average, LOS C is average, and LOS D is below average but still passing (see table 2).

IESNA's minimum standard is LOS D. PCC's standard for horizontal illumination is also LOS D by the time it is converted back to footcandles at the pavement. PCC's uniformity ratio standard, however, is LOS B or better. LOS A illumination levels for covered parking areas were determined on the basis of the lighting requirements of airports and shopping center parking facilities, which demand a higher level of lighting, and American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)/IESNA¹⁰ energy standards.

Lighting fixtures selected for a parking facility must do more than just provide ample, glare-free lighting. As a key component of the security system, they must also be reliable, easy

to maintain, able to withstand the elements, and protected from vandalism. In summary, if local officials wish to encourage or mandate security in parking facilities, the single most effective thing they can do is to require good lighting.

Concrete stain. Staining concrete is a cost-effective method of increasing general brightness and creating a sense of well-being.¹³ White stain on ceilings and beam soffits reflects light, thereby increasing uniformity. Depending on the circumstances, staining ceilings and beam soffits white may improve the lighting level of a particular design by as much as one level of service (see table 2). A good quality concrete stain will last at least 10 years in these locations. Paint creates the same brightness but requires increased maintenance.

On the other hand, white stain on walls seems to encourage graffiti, which tends to hurt the perception of security. Instead of white stain, anti-graffiti coatings may be used on walls, if desired, to enable quick and easy cleaning.

Natural surveillance

Parking consultants consider natural surveillance—the ability to observe one’s surroundings—to be the next most critical security design issue after lighting. Natural surveillance is easier to achieve in surface parking lots; however, relatively minor design changes can significantly improve natural surveillance in other types of parking lots and garages.

Although complicated sloping floor designs were the state of the art in parking garages 20 years ago, today the goal is generally to maximize flat parking areas and minimize ramps. This approach, which essentially produces

a series of surface lots stacked vertically, possesses most of the inherent advantages of natural surveillance found in single-level parking lots.

Openness also enhances natural surveillance. Long-span construction and high ceilings create openness and aid in lighting the facility. Building codes currently require a minimum amount of openness on the exterior facade of parking facilities to provide natural ventilation. There is a real cost benefit to meeting the requirements for an open parking structure because the cost of sprinkling equipment and ventilation for enclosed garages is significant.

When possible, however, the openness of the facade should be maximized for crime prevention. For example, a code may only require openness on two sides; however, openness on four sides is preferable. Obviously, an underground structure cannot be open. However, grading the site down

to open up the first level below grade or using area wells allows both natural light and ventilation to reach the lower level. This improves the perception of security and also may enhance natural surveillance—in the audible if not visible mode.

Building codes often require fire walls along common property lines, but these can be avoided if the structure is held back the required distance for unprotected openings. Conversely, providing openings along a side that is 6 to 10 feet away from the fire wall of an adjacent building does little for CPTED and requires extra security (such as patrols or alarms) to control access to the resulting alleyway.

Shear walls should be avoided, especially near turning bays and pedestrian travel paths. Where shear walls are required, large holes in such walls can improve natural surveillance.

Table 2: Level of Service of Lighting

LOS	Maintained Illumination Levels (footcandles)			
	D	C	B	A
Horizontal illuminance at pavement, average^a				
Covered parking areas ^{b,c,d}	5	6-7	8-9	10
Roof and surface parking areas	1	2	2.5	3
Stairwells, elevator lobbies	10	12-14	16-18	20
Uniformity ratio (average: minimum)	4:1	4:1	3:1	3:1
Uniformity ratio (maximum: minimum)	10:1	10:1	8:1	8:1
Vertical illuminance 42 inches above pavement, minimum				
Covered parking areas	1	1.2	1.4	1.6
Roof and surface parking areas	0.13	0.25	0.31	0.38
Stairwells, elevator lobbies	1.3	1.6	2.1	2.5
Uniformity ratio: none				

Source: Smith, Mary S. 1995. "Chapter 2, Functional Design." *Parking Structures: Planning, Design, Construction, Maintenance and Repair, Second Edition*. New York: Chapman and Hall.

Notes:

^a Horizontal illuminance should always meet or exceed IESNA recommendations, not including reflectance.

^b Increase average minimum daytime lighting at vehicular entrances to 50 fc, minimum.

^c Increase average minimum daytime lighting at vehicular exits to 20 fc, minimum.

^d Increase average minimum daytime lighting on express ramps to 10 fc, minimum.

Pedestrian paths should be carefully planned to concentrate egress. For example, bringing all pedestrians through one portal rather than allowing them to disperse through numerous exits improves the ability to see and be seen by others. Likewise, concentrating vehicular entrance and egress to a minimum number of locations is beneficial. Attendant booths, parking offices, and security stations should be located where attendants can directly monitor activity.

Dead-end parking areas as well as nooks and crannies in the general design of the parking facility should be avoided. Shrubbery should be planted away from the facility and kept trimmed to eliminate hiding places. The facility should always be well maintained; trash, beer cans, and graffiti may leave the impression that the facility is not secure.

Another means of enhancing natural surveillance is to bring retailers or restaurants into the area. Patrons frequent such establishments when activity in the parking facility would otherwise be low, thereby increasing natural surveillance of the property. The owners and employees of these businesses would also have a vested interest in the security of the parking facility.

Stairtowers and elevators

Historically, stairs, lobbies, and elevator cabs have been at highest risk for personal injury incidents in parking facilities. One of the main reasons is that they have typically been enclosed, small spaces that attract persons with criminal intent. Therefore, one of the most basic precepts of CPTED in parking design is to design stairtowers and elevator lobbies as open as code permits. The ideal solution is a stair and/or elevator waiting area totally open to the exterior and/or the parking

areas. If a stair must be enclosed for code purposes or weather protection, glass walls can reduce or eliminate the incidence of both personal injury attacks and various types of vandalism. Potential hiding places below stairs should be closed off.

Other CPTED design elements include glass backs for elevator cabs and well-lit elevator lobbies that are visible to both patrons in the parking areas and the public out on the street. When enclosure is required, as in underground parking garages, an automatic fire door, or for a larger opening, a rolling fire shutter with an access door, can be installed so that the area is wide open during normal use. Either the door or shutter would be closed by a smoke detector when needed.

Access control

Although natural surveillance may be adequate for low-risk facilities, higher risk ones often require access control. Access control and perimeter security are best considered in the initial design stage. Even if a potential parking facility site is in a low-risk area, the risk level may change in the future.

Security screening or fencing can be provided at points of low activity to discourage anyone from entering the facility on foot yet still maintain openness and natural surveillance. A system of fencing, grilles, and doors also may be designed to completely shut down access to the entire facility during unattended hours.

Any ground level pedestrian exits that open into nonsecure areas should be emergency exits only and fitted with panic bar hardware. Local alarms that activate if a ground level door is opened can be useful when an exit is intended for emergency use only.

Controlling vehicular access to a parking facility, even a public one, is extremely beneficial to security. Merely requiring the driver to take a ticket on entry (often observed by a security camera) and interact with a booth attendant at exit will make a facility less attractive to criminals than one that is wide open and unattended.

Signs and graphics

Careful placement of signs and graphics helps orient patrons and allows them to move quickly in and out of the parking facility, making them less vulnerable to attack. Color coding and/or unique memory aids also help patrons quickly relocate their parked vehicle when they return to the facility. Signs and graphics can also assure patrons that their safety is being monitored. Likewise, potential perpetrators may be deterred by a notice that they are under surveillance.

Restrooms

Parking facility owners, operators, and consultants all agree that public restrooms present a security problem because their use is infrequent and hiding places abound. Public restrooms are safer in office buildings and shopping centers where there is more activity. If they are provided in a parking facility, however, they should have maze-type entrances instead of outer/inner doors that could trap a victim.¹⁴

Active security systems as CPTED enhancements

Emergency communications do not provide a complete solution to security problems in a parking facility and cannot compensate for a lack of CPTED. On the other hand, panic buttons, intercoms, sound surveillance, and

CCTV can be practical enhancements to CPTED in a high-risk facility.

Panic buttons and emergency phones

Panic buttons are often located in elevators, lobbies, stairs, and occasionally in parking areas. Their value, however, is dependent on the victim reaching the button and sounding the alarm. A drawback of panic buttons is that they seem to be irresistible to pranksters. Telephones are another emergency communication device; however, they are more expensive to install and maintain and may be difficult to reach when trying to sound an alarm.

Intercoms

Panic buttons with voice-activated intercoms can be installed in all elevator cabs and fully enclosed stairwells. Two-way intercoms make it possible to communicate to the victim that help is on the way, possibly deterring the criminal. In recent years, a constant blue light that changes to strobe when a panic button is depressed has become a common accessory to panic/intercom systems. The strobe light may attract the attention of more distant parking patrons and cause the criminal to flee.

Sound surveillance

Sound-activated systems continue to be problematic. Standard voice-activated systems are generally not practical in parking areas due to background noise. Scream alarms filter out general background noise but identify screams and breaking glass. A drawback of these systems is that security personnel tend to tire of their irritating, routine sounds and turn off the sound activation.

CCTV

CCTV can provide multiple levels of surveillance; however, it is important to

recognize its inherent strengths and weaknesses for it to be an effective component of an overall security plan.

CCTV can be used to detect personal assaults in enclosed areas (such as stairtowers) that are historically at highest risk. The knowledge that camera images can be recorded to a VCR, increasing the likelihood of identification and conviction, may deter the criminal. Parking areas may also be monitored by CCTV; however, parked vehicles, sloping floors, and shadows make it difficult to position cameras to fully cover all areas.

A recent advance in parking security is the development of a CCTV camera that rides a track back and forth down the length of parking aisles. The camera can see between parked vehicles, and a variety of devices can be used to trigger the camera to go to a specific location. The first working installation of the system was completed in a parking facility at Duke University Medical Center in 1993. As of this writing, the security staff is satisfied with the device and is planning to install others. A vertically mounted version of the system that could be used in stair and elevator towers is now in development. If complete CCTV coverage of a parking facility is necessary, these mobile cameras are more cost-effective and provide better coverage than standard pan-and-tilt cameras.

Comprehensive CCTV and emergency communication coverage throughout a parking structure adds as much as \$400 per parking space (1995 dollars) to the construction cost of a new facility, but retrofit expenses can be double this amount. The CCTV must then be monitored by

trained security officers and maintained by skilled technicians. In such situations, the combined cost of security expenses and liability insurance can represent 25 percent or more of a parking facility's total annual operating cost.

Security personnel

The visible presence of uniformed officers is one of the best crime prevention methods and should be considered in high-risk facilities. Unscheduled patrols who vary their routes throughout the shift appear to be most effective. In very high-risk situations, check-in stations at key locations should monitor and record the frequency of patrols. All security personnel should be trained to properly monitor, operate, and respond to all security equipment within the facility.

Selecting appropriate security features

When it comes to selecting appropriate security features, a one-size-fits-all approach will not work. All design processes involve balancing competing goals and objectives, and each project has its own balance. For example, in one situation, heavy landscaping and screening may be important to minimize the intrusion of a hospital parking facility into an adjacent residential neighborhood. However, if the hospital is located in a high-crime area, heavy landscaping and screening may be inappropriate.

In general, the selection of appropriate security features depends on the vulnerability to crime of various locations within the facility. The neighborhood in which a facility is located will usually have the greatest effect on this factor: The higher the general level of crime in

a neighborhood, the greater the vulnerability of a particular facility.

Security audit

Before appropriate security features are selected, a security audit should be conducted. The audit involves developing an incident history and profile for a neighborhood by contacting the local police and the managers of nearby facilities. Using this information, facilities are classified as one of the following:

- **Low risk** — Facilities in which minor vandalism and juvenile theft problems may occur, but no personal injury incidents and no professional theft activity may reasonably be anticipated.
- **Moderate risk** — Facilities in which a vehicle theft may occur during nonbusiness hours, but there is no reason to anticipate personal injury attacks.
- **High risk** — Facilities in which personal injury incidents have occurred, or a pattern of thefts might escalate to personal injury.

The security audit identifies isolated locations in moderate- and high-risk facilities and indicates appropriate active systems. In a moderate-risk facility, active systems are generally only installed in specific locations such as enclosed stairs. In high-risk facilities, a comprehensive security program is usually necessary.

Design features matched to risk level

The second step is to determine how the facility’s design will affect security, either positively or negatively. General guidelines for correlating risk levels with the need for passive and

Table 3: Guidelines for CPTED in Parking Facilities¹⁵

Risk Level	Passive Features	Active Features
Low	As many as possible	For patron perception not prevention
Moderate	High priority in overall design	To correct defects in passive systems
High	Highest priority in overall design	Comprehensive program including CCTV and security patrols

active systems are provided in table 3.

In low-risk facilities, active systems are generally not necessary; however, the parking facility design should allow for later installation of active security systems in case the facility’s risk level increases. For example, with just a little attention to detail in the initial design, control of the perimeter at grade can be easily accomplished later.

As the risk level increases, CPTED becomes a greater priority. Therefore, when conflicts arise between aesthetics and security, the degree of risk will determine whether the balance shifts toward CPTED. It is important to note, however, that many CPTED features can and should be provided in parking facilities at **all** risk levels.

In the past, parking facility owners have hesitated to document their rationale for the specific security measures employed at a facility because they were afraid that such documentation would be used against them in any litigation. However, experience has shown that documentation that shows a thoughtful, rational approach to security planning is of substantial benefit in court. Although experts may argue over exactly which measures should have been adopted, being able to show that options were carefully considered and that reasonable, prudent measures were taken to reduce risks generally reduces overall liability.

What can local officials do to encourage CPTED?

Although local officials are not often consulted in the design process, municipal governments do have a major influence on the design of buildings, and local officials can play a much stronger role in fostering good security planning.

Building codes

Building codes should reflect security considerations as well as the traditional concerns about effects on human life from such natural forces as wind and snow, fires, earthquakes, and tornados. Indeed, the threat to life from criminal attack is far greater than that from fire in a parking structure. According to National Crime Victimization Study data,¹⁶ more than 500,000 violent crimes occurred in parking facilities (both lots and structures) in 1992, whereas a study of national fire data¹⁷ reported only 9 injuries—6 of which were to fire fighters—and no deaths in 404 fires over a 3-year period.

A prime example of a building code requirement oriented to fire safety to the detriment of CPTED is the enclosure of exit stairs in open parking structures. These enclosed spaces that experience little activity provide natural hiding places and are prime locations for assaults. Because open parking structures allow for the dissipation of smoke and fumes, stair en-

closures do not seem to be necessary for safety from fire.

National building codes have recognized this fact and no longer require enclosed stairs in open parking facilities. However, the National Fire Protection Association Life Safety Code continues to require enclosed stairs, and many local officials feel obligated to enforce it. Local officials should consider meeting with officials of their fire departments to discuss how to balance the needs of fire safety and CPTED.

Zoning ordinances

Local zoning ordinances occasionally require that parking lots be totally screened with landscaping. They also limit light pole heights and constrain other elements that are critical to security design.

Local officials should consider reviewing and modifying ordinances to encourage CPTED. Local codes can require that the lighting of new parking lots and garages be designed in strict conformance with IESNA standards, as periodically revised and updated.

The Minneapolis ordinance

Some local communities have reacted to a rash of parking facility crimes by trying to mandate specific security features in parking facilities. Following two rapes and two murders in parking facilities in June 1988, the city of Minneapolis adopted an ordinance in 1990 mandating specific security measures, primarily in parking structures. The standards basically cover five areas. (Author comments are in italics.)

Area 1. In new parking structures, elevator lobbies and stairtowers shall have glass enclosures, and glass-back

elevator cabs shall be provided where those elements are above grade. The ordinance also requires architectural screening at open exterior walls to two floor levels above pedestrian access.

The requirement for architectural screening results in enclosure rather than natural surveillance into parking facilities.

Area 2. Some design standards are applied to both new and existing facilities, effectively requiring the retroactive installation of CPTED. Lighting levels and certain pedestrian signage are mandated.

Lighting levels are substantially different than IESNA standards. The same average maintained horizontal footcandles are prescribed, but at 5 feet above the floor, rather than at the pavement. By the time the illumination is measured at the floor, the illumination levels are substantially lower than IESNA minimums and would be classified as LOS E. The practicality of some of the signage, at least for CPTED, is doubtful. For example, several of the requirements are for tactile signs for use by persons with visual impairment.

Area 3. Certain active security measures are required at all existing and new structures, including audio and visual surveillance equipment at stairwells, lobbies, elevator cabs, and vehicular entrances and exits. Audio and visual equipment must be sound activated, panic exit devices must be installed at all pedestrian exit points, and audio and visual equipment must be monitored during all operating hours. Alternative means of ensuring safety must be taken if the equipment is rendered inoperable for more than 24 hours.

One of the specific incidents triggering the Minneapolis ordinance occurred in an employee parking facility owned by Honeywell, considered a security-conscious company.¹⁸ The company had a sound-activated electronic security system, but Honeywell had turned it off because of screeching birds, squealing tires, and honking horns. Despite this, the city of Minneapolis specifically mandated sound-activated systems.

Area 4. The facility must be inspected every hour by security patrols or a facility employee. When an individual is observed sitting in a vehicle, the individual making the inspection shall check the vehicle to make sure there is no problem. Facility personnel shall receive instruction in the monitoring of audiovisual and alarm devices and the proper way to approach individuals to ensure they are customers/visitors and have parked in the facility.

Area 5. The ordinance contains two requirements. "Major events in downtown Minneapolis that create large parking demand will have additional security to ensure adequate security. All facilities will provide escort services based on their individual demand and post a sign at the entrance defining the service and hours available."

The St. Paul ordinance

Whereas the Minneapolis ordinance is more oriented to active security than CPTED, the St. Paul city ordinance is much less restrictive. Its basic criteria include the following:

- All nonvalet parking structures must have lighting in conformance with IESNA standards.
- Interior walls must be painted a light color (white or light blue) to improve illumination.

- Signs must be posted to inform users whether an escort service is available.

The local crime records prior to this period did not aggregate data on parking-related crimes; therefore, there is no way to determine whether the Minneapolis or St. Paul ordinances have had any measurable effect on crime rates in parking facilities. In the Blue Ribbon Commission¹⁹ report, the St. Paul Police Department was able to confirm 42 “serious” sexual assaults in parking facilities out of a total of 1,540 reported rapes from 1981 to 1987. Of the 42 assaults, 15 occurred in residential parking facilities, 4 occurred in parking garages, and the remainder occurred in parking lots.

The Pittsburgh ordinance

In 1983, Pittsburgh mandated active security systems in parking garages

that charge guests, employees, or the general public. The requirements of this ordinance include the following:

- Uniformed security guards must patrol the facility every 30 minutes.
- Patrols must check in on every level, verifying the patrol.
- Emergency buzzers must be installed on each level.
- Lighting must emit a minimum of five footcandles.
- Emergency phones must be installed in elevators.
- Directional arrows indicating exits and elevators must be painted on walls.

None of these ordinances focus on considering security in terms of the specific needs and constraints of an individual facility. Therefore, rather than thoroughly assessing a particular facility’s risk, parking facility owners may be content to merely follow the city’s requirements. In addition, the ordinances’ demands for specific active measures may monopolize funds that could be spent on other more efficient and effective security measures. All the cited ordinances encourage active security solutions rather than CPTED.

A framework for ordinances

CPTED concepts should be incorporated in municipal regulations for parking lots (see “Rationale for CPTED in Parking Facilities”). The single most important CPTED security feature a city can mandate is lighting. Usually, designers are responsible for meeting lighting codes whether or not the city checks them. However, it would be relatively easy for a city to require all new parking facilities to

submit a point-by-point analysis in accordance with IESNA standards and to demand building officials review such an analysis. A next step would be to require local property owners to upgrade lighting in existing facilities using that same standard. A city may also choose to require a higher level of service in some locations; however, it should still tie the standard to IESNA.

Other CPTED measures that could be codified locally include the following:

- Elevator lobbies and stairs in open parking garages shall be open to the parking areas, except at roof levels where glass enclosures may be provided for weather protection.
- Where possible, elevators and stairs shall be located on the perimeter with natural surveillance from exterior public areas via glass-back elevators and glass at stairs and elevator lobbies. The design shall endeavor to permit any individual in the stair or elevator lobby to be seen from the outside.
- At a minimum, a conduit shall be provided for emergency communication and CCTV in stairs, elevator cabs, and elevator lobbies.

Rather than require specific active security measures, the city could require facilities to submit a security management plan and update it every 3 to 5 years. The plan would include a security audit and proposed CPTED and active security measures. The plan would be reviewed and approved by the city’s crime prevention specialist.

Although mandating a security management plan places an additional burden on property owners and city resources, all of the security ordinances mentioned in this report contain elements that must be inspected by city

Rationale for CPTED in Parking Facilities

CPTED should be a high priority in virtually all parking facility designs for the following reasons:

- Natural surveillance throughout the design is a low-cost crime prevention strategy.
- Although security may not be an issue in certain locations today, risk levels may change in the future.
- CPTED and active security measures lessen the likelihood that crime will occur and reduce the liability of the parking facility owner if it does.
- Retrofitting a facility to enhance CPTED is very expensive, if not impossible.
- When CPTED features are absent from the general design, more active security systems are generally needed. These systems are costly because they are labor and equipment intensive.

staff anyway. Having crime prevention personnel work with owners to develop comprehensive and site-specific plans is a more proactive and positive deployment of city personnel than inspecting and fining property owners.

At a minimum, a basic understanding of CPTED concepts and their applicability to parking facilities should be considered part of the education of both staff and appointed officials dealing with planning, zoning, fire/life safety, and building codes. Local governments should require that the lighting of parking facilities meet the minimum standards of IESNA. Local law enforcement assigned to crime prevention and community outreach should also be familiar with security design in parking facilities.

Notes

1. *1990 NPTS Databook and Journey to Work Trends in the United States and its Major Metropolitan Areas, 1960-1990*. Note, NPTS stands for the National Personal Transportation Survey.
 2. *Criminal Victimization in the United States, 1992*.
 3. Ibid.
 4. *Journey to Work Trends in the United States and Its Major Metropolitan Areas, 1960-1990*.
 5. These studies are cited in Bachner, J. P. 1986. "Effective Security Lighting." *Journal of Security Administration*, vol. 9, no. 1 (June).
 6. Chism, R.W. 1986. "Lighting: First Line of Defense in Parking Structure Security." *Parking*, vol. 25, no. 5 (September–October): 77–79.
 7. Kaufman, John E., and Jack F. Christensen. 1984. *IES Lighting Handbook, Reference Volume*. New York: Illuminating Engineers Society of America.
 8. Monahan, Donald. 1994. "Top Ten Mistakes Made in Parking Structure Lighting." Presented in September 1994 at the National Parking Association's 43rd International Convention.
- To illustrate this point, the author recently examined the lighting for a new parking facility as part of a design review. The manufacturer of a lighting fixture often used in parking facilities provided a point-by-point computer analysis of horizontal illuminance at the pavement. However, the grid selected for the analysis did not meet IESNA requirements (neither actual minimum nor maximum points were represented), and the assumptions for reflectance off various surfaces did not allow for the depreciation of lamp output over time.
- Therefore, the average horizontal illumination and the uniformity ratio calculations were both incorrect. Vertical illuminance was not even considered. To actually meet the original design criteria under IESNA design standards, twice as many fixtures as proposed would have been required.
9. Smith, Mary S. 1995. "Chapter 2, Functional Design." *Parking Structures: Planning, Design, Construction, Maintenance and Repair, Second Edition*. New York: Chapman and Hall.
 10. ASHRAE/IESNA. 1989. *Energy Efficient Design of Buildings. Standard 90.1-1989*. New York: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
 11. Parking Consultants Council. February 1987. *Recommended Building Code Provisions for Open Parking Structures*. Washington, DC: National Parking Association.
 12. IESNA. 1984. *Recommended Practice RP-20, Lighting Design for Parking Facilities*. New York: Illumination Engineers Society of North America.
 13. Hundt, R.M., and W.C. Arons. 1985. "Planning Parking Protection." Revised from article in *Security Management* (February): 44–47.
 14. College of Engineering, University of Wisconsin, Madison. 1987. "Inhibiting Crime Through Design?" *Building Design and Construction Newsletter*, vol. 3, no. 4 (Fall): 1–3.
 15. Smith, Mary S. 1989. "Chapter 4, Security and Life Safety." *Parking Structures: Planning, Design, Construction, Maintenance and Repair*. New York: Van Nostrand Reinhold.
 16. *Criminal Victimization in the United States, 1992*, Tables 62, 65, and 67.
 17. *Parking Garage Fires*. 1992. McLean, VA: Parking Market Research Company.
 18. "Tale of Twin Cities." 1990. *Parking Security Report*, vol. 1, no. 9 (December).
 19. Minnesota Department of Public Safety. 1988. "Blue Ribbon Commission on Parking Ramp Safety." Final Report, July 29.

Mary S. Smith is Vice President and Director of Parking Consulting and Study Services for Walker Parking Consultants.

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Please note that when free publications are out of stock, they are available as photocopies or through interlibrary loan.

Gordon, Corey L., and William Brill, *The Expanding Role of Crime Prevention Through Environmental Design in Premises Liability*, Research in Brief, 1995, NCJ 157309.

Taylor, Ralph B., and Adele V. Harrell, *Physical Environment and Crime*, Research Report, 1995, NCJ 157311.

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