6.1 INTRODUCTION

For this publication, a central business district and downtown are terms referring to the commercial heart of a city. The events following the attacks in New York City on September 11, 2001, are recorded as among the worst building disasters in history and resulted in the largest loss of life from any single building collapse in the United States.

Since the attacks of September 11, 2001, many security measures were installed in the central business district in New York City. In some cases these installations have been considered successful from a security, architectural, urban planning, and cultural preservation standpoint. In other cases, however, the installation of security barriers has had a detrimental effect. For example, the placement of physical barriers has caused unnecessary interruptions on streets and sidewalks. In many cases, it has minimized the efficiency of pedestrian and vehicle circulation systems, and potentially prevented the access of first responders in case of an emergency. If national security concerns continue, the need for barrier systems of various kinds may increase as our major cities continue to grow. However efficient pedestrian and vehicle circulation systems are also important for day-to-day living, and are critical for emergency response, evacuation, and egress.

This chapter focuses on providing security for typical central business district sites, in which space is limited and many of the measures applicable to open sites cannot be implemented.

6.2 LAYERS OF DEFENSE AND URBAN SITE TYPES

Although the layers of defense for a central business district are very compressed, the general principles still apply. The layers may be narrow and some layers of defense may share the same space. As will be shown, in the zero setback site, the second layer of defense ceases to exist, while building yards and plazas form the second layer. Note that if the sidewalk provides the only defended stand-off, every foot of setback is value.

Three generic site types will be found in the central business district of any large city. These are:

- Buildings with zero setback and alleys: the front wall of the zero setback building face is on the property line. An alley is a special case of a site with zero setback zoning in the form of a narrow street that divides a city block and provides service access to the buildings (Figure 6-1).

Figure 6-1:
Zero setback (left) and alley (right).

- Buildings with yards: the building is set back a small distance from its property line, and the space is usually landscaped. Yards may be on the front, sides, and rear of the building (Figure 6-2).

Figure 6-2:
The building yard.

- Building with plazas: The building is placed within a private or public open space that is publicly accessible (Figure 6-3).

Figure 6-3:
The plaza.

In addition, all sites have a common set of urban elements: sidewalks, streets, and streetscape such as benches, planters, signs, etc.

Planning, design, and placement of security elements in the central business district should not be detrimental to the critical urban design components that contribute to the success of vibrant, livable cities:

- A well-connected street system where the vehicle user and pedestrian have many choices to maneuver through a congested city to maintain traffic flow and pedestrian movement.

- A well-defined pedestrian-scaled streetscape vocabulary that includes a consistent street wall and ample maneuverable areas for walking, waiting for public transit, and enjoying outdoor commercial activities such as eating, vending, window shopping, etc.

- Publicly accessible ground-level commercial, cultural, or educational uses. If these uses cannot be accommodated within the building, then alternatives should be considered, such as outdoor vending or kiosks or types of visually appealing and interesting features along the ground floor of the building.

- Attractive and durable street furniture and utility infrastructure (signage, trees, benches, light poles, trash receptacles, security elements, etc.).

6.2.1 ZERO SETBACK BUILDINGS

Due to the high cost of urban real estate, limited developable area and need to maximize use of space, most central business district buildings are commonly developed with exterior walls on the property line. In this type of site, the area between the property line and the building face, that in the open site provides the second layer of defense, does not exist. The sidewalk provides part of the first and second layers of defense. The third layer starts at the building face, which is also the property line. Often the sidewalk is a grey area, and barriers may be in the sidewalk or the building yard. If barriers are in the sidewalk, the city must review and give permission; if in the owner's property, no permission is necessary (Figure 6-4).

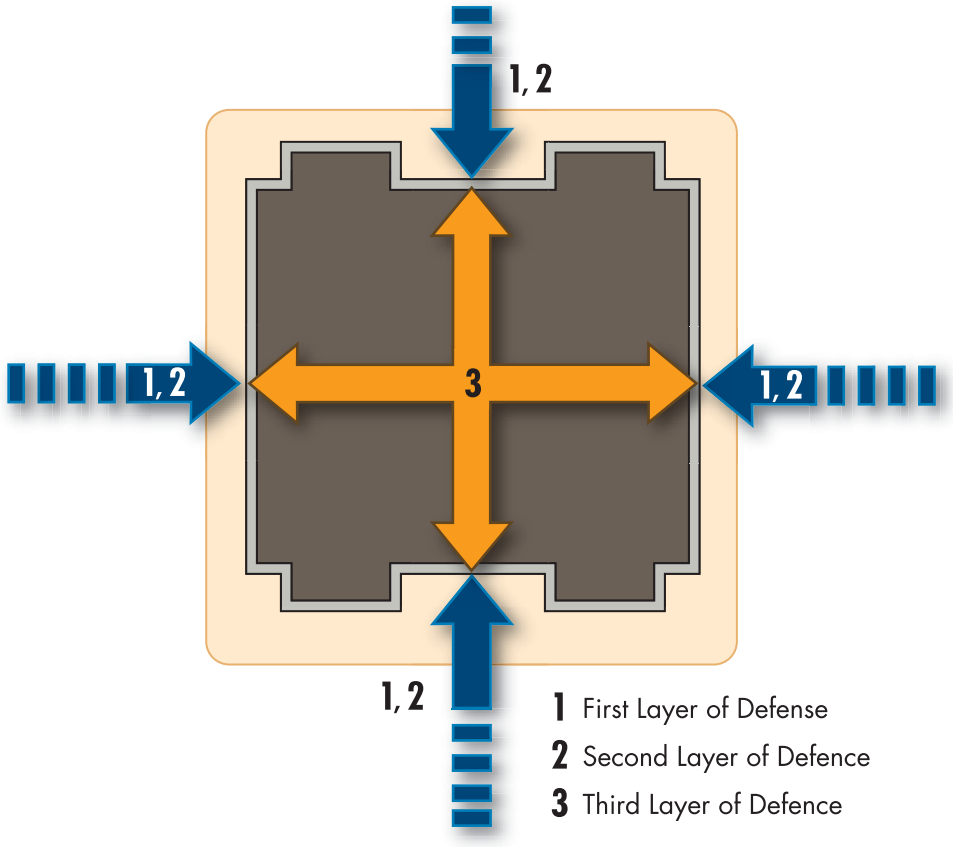


Figure 6-4:
Layers of defense for zero-setback building.

When the property line is at the face of the building, the total space for perimeter barriers shrinks to a few feet of public sidewalk, and the street may be only a narrow alley primarily used for delivery. In these circumstances the strategies are limited and often challenging to employ due to space limitations and conflict with day to day use of the building and site. When planning barrier systems, the removal of curbside parking, or street closures, the following issues need to be considered:

- Placing barriers within the sidewalk may cause long-term impairment of public mobility on sidewalks increased traffic congestion due to loss of traffic lanes and on-street parking, and may not be welcome or desirable. Limiting pedestrian movement in downtown districts and restricting access to stores, restaurants, offices and apartments can have a negative impact on the functionality of urban life and the viability of a city neighborhood.

- In many areas, street parking is often located within a desired stand-off zone. This parking is sometimes prohibited to increase the stand-off distance, but this practice should be avoided as much as possible (Figure 6-5).

Figure 6-5: Permanent removal of parking from the curb lane of a major building results in a day-to-day inconvenience.

SOURCE: NCPC

- Curbside parking should not be removed unless additional stand-off distance is absolutely necessary for high-risk buildings. High curbs and other measures may be installed to keep vehicles from departing the roadway in an effort to avoid security counter measures. When required, sidewalks can be widened to incorporate the area devoted to the curb lane.

  In some instances, prohibition of street parking or lane closure can be used as a temporary measure during times of increased alert. Temporary closure against enhanced threat should be carefully planned rather than improvised with ugly and disruptive measures (Figure 6-6).

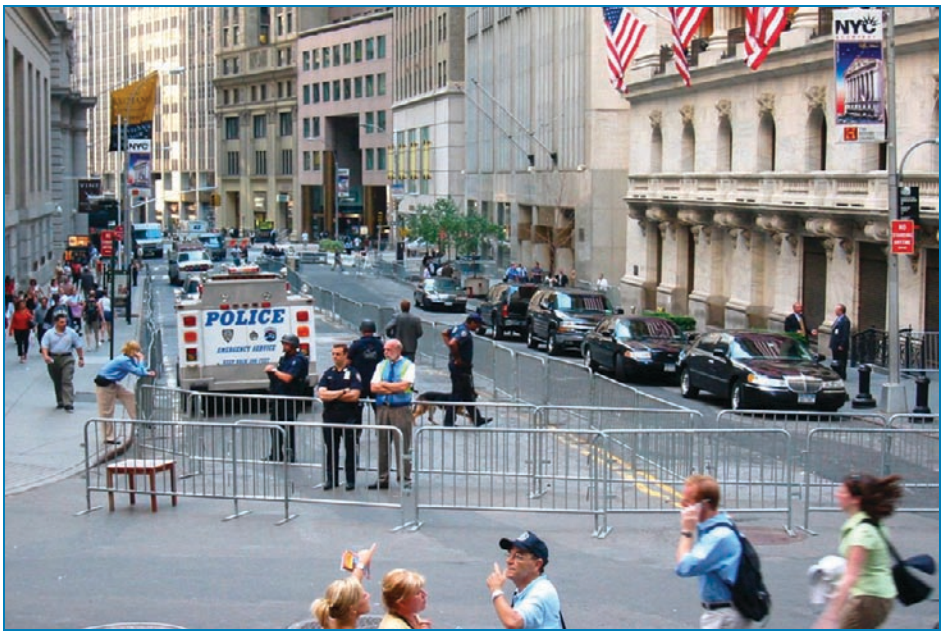


Figure 6-6:
Improvised street closure and control.

In order to obtain adequate stand-off and restrict vehicular access in urban locations of very high risk, street closures and vehicular control and inspection can be considered. This solution should be carefully planned to establish its overall feasibility, based on its impact on the transportation infrastructure and possible disruption to local traffic patterns. A traffic study is necessary to provide more details of the impact of street closure and vehicular control and inspection on the local traffic pattern and neighborhood usage.

When street closure is not feasible to provide adequate stand-off, a solution is to harden the building structure, glazing, and openings, and provide increased surveillance and security. Complete hardening of the structure and exterior envelope is realistic for a new building but very expensive for an existing one. Careful investigation may show that partial hardening, such as the lower floors of glazing and some strengthening of exposed perimeter columns, will reduce the risk to an acceptable level. Increased surveillance should also be provided to identify suspicious vehicles on adjacent streets, together with effective screening at public entrances and service areas.

- It may be desirable to regulate the type of traffic in urban areas to restrict the size of vehicles: for example, to prohibit truck traffic in certain zones to reduce the risk of a particular magnitude of explosion.

In a central business district in which the threat to an individual building is relatively low, the building is well constructed, and the possibility of a head-on high-velocity vehicle attack is minimal, acceptance of

risk may be the most reasonable course of action. Many older buildings (late 19th and early 20th centuries) are strong structures consisting of a steel frame encased in masonry or concrete, with small window openings and masonry walls. Earlier buildings may have load-bearing walls with massive lower floor walls. They may withstand considerable impact, but if once breached, progressive collapse may be more likely than for steel or reinforced concrete framing.

In summary, the central business district requires a compromise solution that involves some or all of the following measures:

- Provide a barrier at the sidewalk edge to obtain a few more feet of stand-off and prevent vehicles mounting the sidewalk.
- Remove critical functions from the lower floors.
- Strengthen glazing and frames.
- Harden loading docks and garage areas.
- Use intensive surveillance by cameras and security personnel.

Sidewalks are often only about 10 feet wide and as little as 6 feet in alleys, making it impossible to establish adequate stand-off distance. For high-threat sites, a perimeter barrier at the edge of the sidewalk (but allowing space for car doors to open) both protects pedestrians from close traffic and prevents potential attackers from mounting the sidewalk.

Figure 6-7 shows a building that has a 7-foot-wide sidewalk facing a narrow street that is, nevertheless, an important roadway that must be maintained; the protection shown is temporary. The building defense relies on preliminary screening at the sidewalk behind temporary metal barriers, followed by full control and search within the building entrance. Jersey barriers are placed at curbside to protect pedestrians from traffic and prevent a passing attacking vehicle from mounting the curb and evading pursuit.

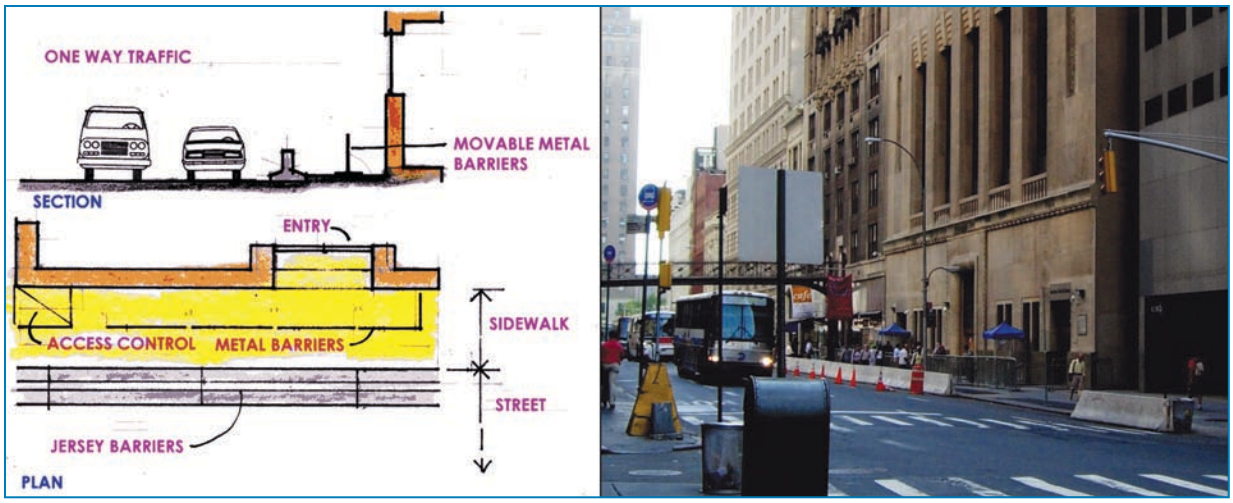


Figure 6-7:
Unsatisfactory example of temporary protection for a high-risk zero-setback building. If the Jersey barriers are not embedded, they can be pushed aside by a vehicle.

Use of Jersey barriers as shown in Figure 6-7 above is undesirable, because they are not an effective barrier, are unattractive in appearance and may interfere with car door opening. This is a temporary version of the more satisfactory engineered bollard layout shown in Figure 6-8. In this instance, the sidewalk serves as the second layer of defense. Well-designed engineered bollards inset from the sidewalk edge, and interspersed with trees, allow for car door opening, prevent an attacker from mounting the sidewalk, and provide the everyday advantage of protecting pedestrians from normal traffic on a busy street. Temporary metal barriers are used between curb and building when a screened entrance is in use, and the engineered barriers at the sidewalk delineate the transition to the first defense layer.

Figure 6-8:
A well-designed zero-setback protection. The engineered bollards define the transition between the first and second layers of defense and the street trees soften the intrusion of bollards.

6.2.2 ALLEYS

The most extreme forms of the zero-setback building are found in alleys: a typical alley roadway has a width of about 20 feet, with a sidewalk perhaps as little as 6 feet wide. Sometimes there is a sidewalk on only one side of the alley (Figure 6-9).

Figure 6-9: Alleys. Note single sidewalk (right).

The protective measures described above for zero-setback buildings apply to buildings serviced by alleys.

In alleys and typical urban streets, adequate stand-off distance is often an impossibility without street closure, but permanent closure is often not feasible because of service entry needs. In this instance, street closure that also allows service access can be achieved by use of active barriers, such as retractable bollards or other devices, together with security personnel and well-planned screening and inspection facilities.

Well-planned and well-designed street closures can enhance the quality of a street, even in a high-risk area. It is critical that a permanent street closure be planned, not only as part of an organized traffic study that respects existing traffic patterns, but also tries to find an opportunity to improve them and enhance the neighborhood. Control of vehicular speed is also important for security. This is discussed in Section 5.4 but some of the methods noted in that section (such as traffic circles) may not apply in the urban environment because of lack of space.

Security measures can be both effective and attractive if design attention is focused on the required performance, and imagination is used in materials and forms. Good design requires site-specific, context sensitive solutions. The function of the public realm and the site's context must be carefully considered when designing and placing hardened streetscape elements, and placement of these elements must be carefully evaluated to avoid visually and physically cluttering the streetscape. Solutions should not be universally applied. In some cases, in important historic areas of cities or in relation to important historic buildings, security elements in public space should be discouraged altogether.

Case Study 6 provides an example of a well-researched neighborhood protection plan that uses street closure to provide stand-off and also enhances the urban values, vitality, and function of the protected area.

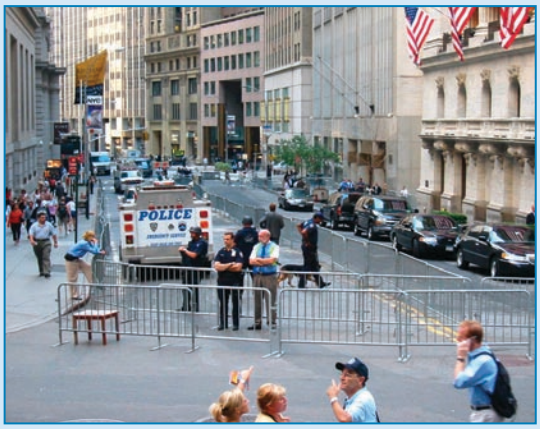
CASE STUDY 6: NEW YORK CITY FINANCIAL DISTRICT

1.0 INTRODUCTION

1.1 Project Scope

After 9/11, the New York City Financial District was identified as a likely target for terrorism. The City of New York and the New York Stock Exchange (NYSE) took immediate steps to secure the perimeter of the financial district. The city's public spaces suffer from heavy-handed, quick-fix installations of cumbersome security devices that mar the experience of the public realm.

The financial district is a close irregular pattern of streets heavily traveled by automobiles, service vehicles, and pedestrians; to create sufficient stand-off for the NYSE would entail closing a number of streets. This was initially accomplished by a vast array of jersey barriers, barricades, and stationary pick-up trucks to block incoming traffic, together with increased security personnel and manned check points that had a negative effect on the quality of the city's public spaces.



Rogers Marvel Architects led a multidisciplinary team that included Quennell Rothschild Partners (landscape), Weidlinger Associates (force protection), Ducibella Ventor and Santore (security) ands Philip Habib Associates (traffic). In addition, a number of public agencies were involved, including the NYC Department of City Planning, the Lower Manhattan Development Corporation, the NYC Economic Development Corporation, the NY Stock Exchange (NYSE), the NY Police Department (NYPD), and the NYC Department of Transportation. The plan recognizes that the real problem is not security itself, but how to prevent the threat of attack from destroying the urban fabric, preserving a psychology of openness, and treating security as an amenity within the public realm.

CASE STUDY 6: NEW YORK CITY FINANCIAL DISTRICT (continued)

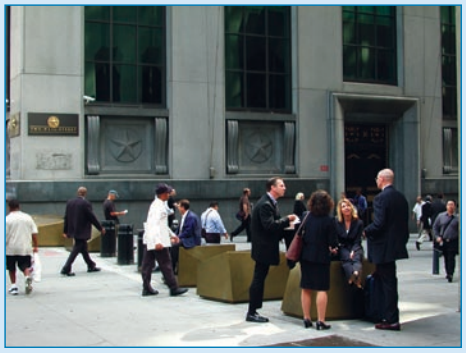
2.0 THE DESIGN APPROACH

2.1 Issues Addressed

The basis of the Rogers Marvel team's approach was to build only amenities. Security was seen as an urban design problem, involving the use of security dollars to create or enhance public space. That way, the finished project would benefit the community, whether or not the security features were ever put to the test.

The security infrastructure is programmed for civic functionality as well as protection. This entailed four strategies:

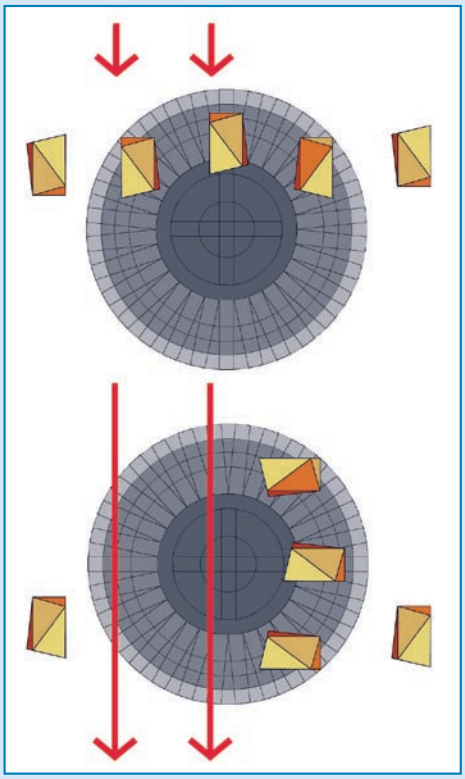
- Rethinking the way the financial district works in terms of circulation and security
- Changing the traffic pattern and lessening the impact of security measures
- Dispersing the necessary protection element among streetscape elements
- Because of the density of the urban space, making every inch count



2.2 Security Strategy

First Layer of Defense

- Perimeter barriers consisting of bollards and specially designed sculptured forms used to provide street closures. The sculptured forms, or "NOGOs," need only a shallow foundation and add an interactive element to the streetscape.
- Controlled access was maintained by rotating road barriers, turntables, and other operable barriers.



CASE STUDY 6: NEW YORK CITY FINANCIAL DISTRICT (continued)

Second Layer of Defense

- Judicious street closures, with controlled access, in order to provide adequate stand-off from possible target assets.
- Closures carefully planned to enhance pedestrian experience and create well-used pedestrian plazas.

Third Layer of Defense

Many of the key buildings in the district are older buildings well constructed in a monumental style. Individual owners have pursued appropriate defense measures depending on the nature and location of their assets.

2.3 Blending with the Neighborhood Context

This project uses a family of specially designed streetscape elements that reinforce the identity of the financial district and the NYSE area. In addition, the project addresses this generation's threats with proposals that connect the programmatic needs of the contemporary streetscape with the original canal and security perimeter of New Amsterdam.

Road beds are remade using walkable cobble stones as a surface, further defining the "pedestrian space." Lighting and open spaces are added to create a sense of community within the financial district.

3.0 INNOVATIONS AND BEST PRACTICES

This project was largely responsible for the development of a number of streetscape items. It successfully illustrates ways to treat security as an amenity instead of a burden.

The security design established a vehicle-free pedestrian plaza on Broad Street and added pedestrian-oriented street lighting throughout the district. The financial district is no longer a workday community emptying after the trading floor closes. Through rezoning and redevelopment, the character of the district is changing to a 24-hour community with restaurants, schools, retail, and resident families.

CASE STUDY 6: NEW YORK CITY FINANCIAL DISTRICT (continued)

The NOGO sculptured barrier and the "turntable" are described in section 4.6.

In addition, reinforced glass street furniture and specialized street lighting have been developed.

WALL STREET AND BROADWAY BEFORE (LEFT) AND AFTER (RIGHT).

6.3 BUILDING YARDS

Some buildings have a "yard" between the building face and the sidewalk. The yard is within the property line and typically consists of a grassy or planted area adjacent to the building. Yards are usually provided for governmental or institutional buildings in which coverage of the entire property may not be as economically critical as it is in private development. Yards are typically narrow, on the order of 10 to 20 feet, providing some stand-off distance beyond the sidewalk.

Although compressed, the three layers of defense can be identified in the building with a narrow yard shown in figures 6-10 (plan) and 6-11 (section). The curb lane and the sidewalk together form the first layer of defense. The sidewalk serves as the common space for pedestrian movement, activity, and interaction. The building yard is the second layer of defense. In the yard, security components should complement the building architecture and the landscaping, because they will be easily visible from the sidewalk, and should be located near the outer edge of the yard. An engineered planter or plinth wall can provide a good security barrier for this layer. The third layer of defense is at the face and interior of the building.

Figure 6-10:
Layers of defense for a building with yards (plan).

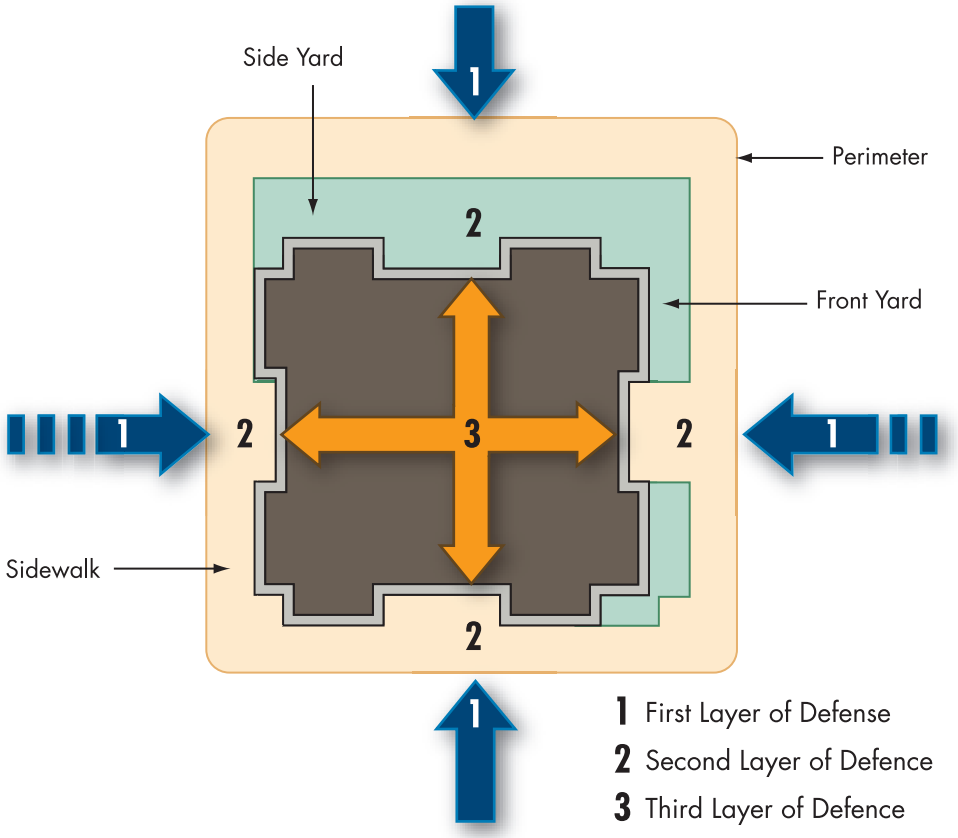
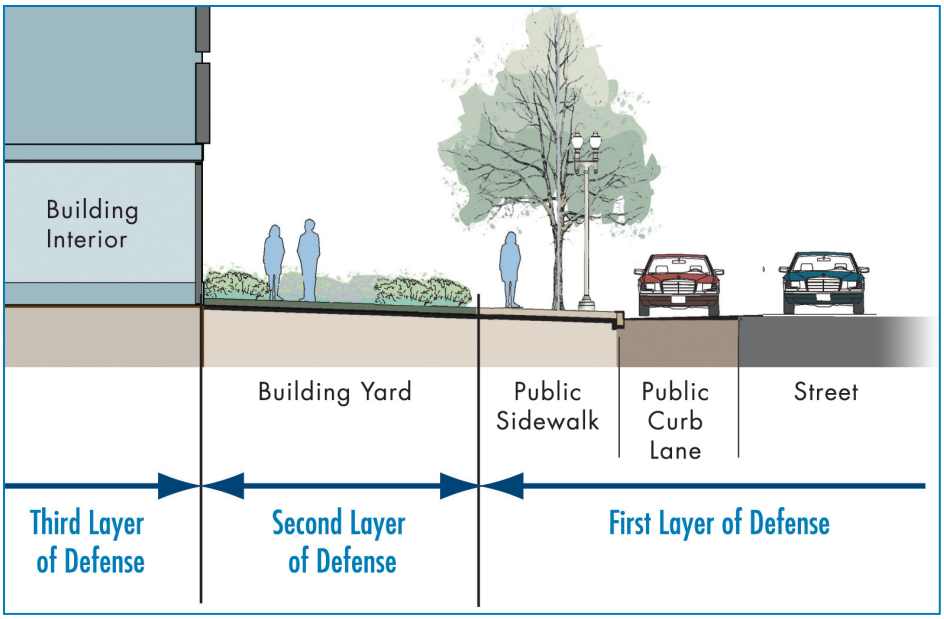


Figure 6-11:
Layers of defense with a yard (section).

SOURCE: FEMA E155



Some major public buildings may have wide yards in the form of landscaped forecourts that can offer reasonable stand-off distance. Sometimes small yards (within the property line) are matched with a wide sidewalk provided by the city: the one shown in Figure 6-12 is about 40 feet wide, which begins to offer useful stand-off.

Figure 6-12:
Narrow yard with a raised planter (left); narrow yard and low planter with a wide sidewalk (right).

A flush or low planter provides little or no protection from vehicles, but an engineered planter or high retaining wall and planter can be an effective barrier (Figure 6-13).

Figure 6-13:
A typical raised low planter (left) may be too low to present a significant barrier to vehicles. The high stepped yard (right), which runs along the side of the building, is a significant barrier and could also act as a blast deflector from a curbside vehicle.

Security elements within the building yard should complement the building architecture and landscaping, and should be designed to appear as well-designed landscape objects rather than as security measures (Figure 6-14).

Figure 6-14:
Barriers in harmony with the architecture. The seating (left) and the serpentine wall (right) are engineered barriers.

SOURCE: NCPC

6.4 PLAZAS

When extensive business district development with very large buildings began after World War II, and the straight tower with no setbacks became fashionable, new ordinances permitted building developers to construct taller buildings, with greater floor area, if a public plaza were incorporated (Figure 6-15).

In essence, the plaza is an extended building yard that was moved outside the controlled access to the building and became public space provided by the developer.

Plaza layers of defense are similar in arrangement to those of the yard. The additional space provided by plazas enables a more effective second layer of defense to be achieved in an urban setting, and often an acceptable stand-off distance can be created on one or more faces of the building, depending on the plaza-building relationship. Figure 6-16 shows the layers of defense with a plaza.

Figure 6-15:
Major office building situated on a public plaza.

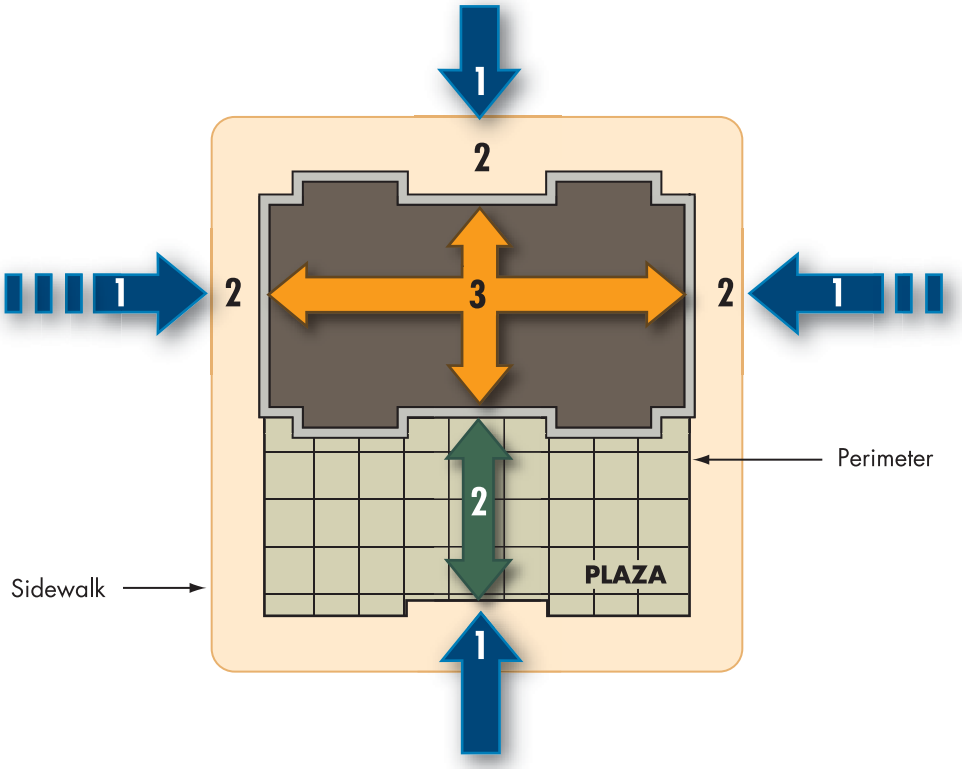


Figure 6-16:
Layers of defense for a plaza.

Public buildings are frequently located within large plazas that are carefully designed to provide pleasant spaces for people to relax, converse, and enjoy the outdoors in a more spacious urban setting.

The plazas also provide an opportunity to install barriers within the second line of defense – the plaza itself. Designers are now experimenting with the use of interesting forms intended to enhance the experience of the plaza while improving security (Figure 6-17).

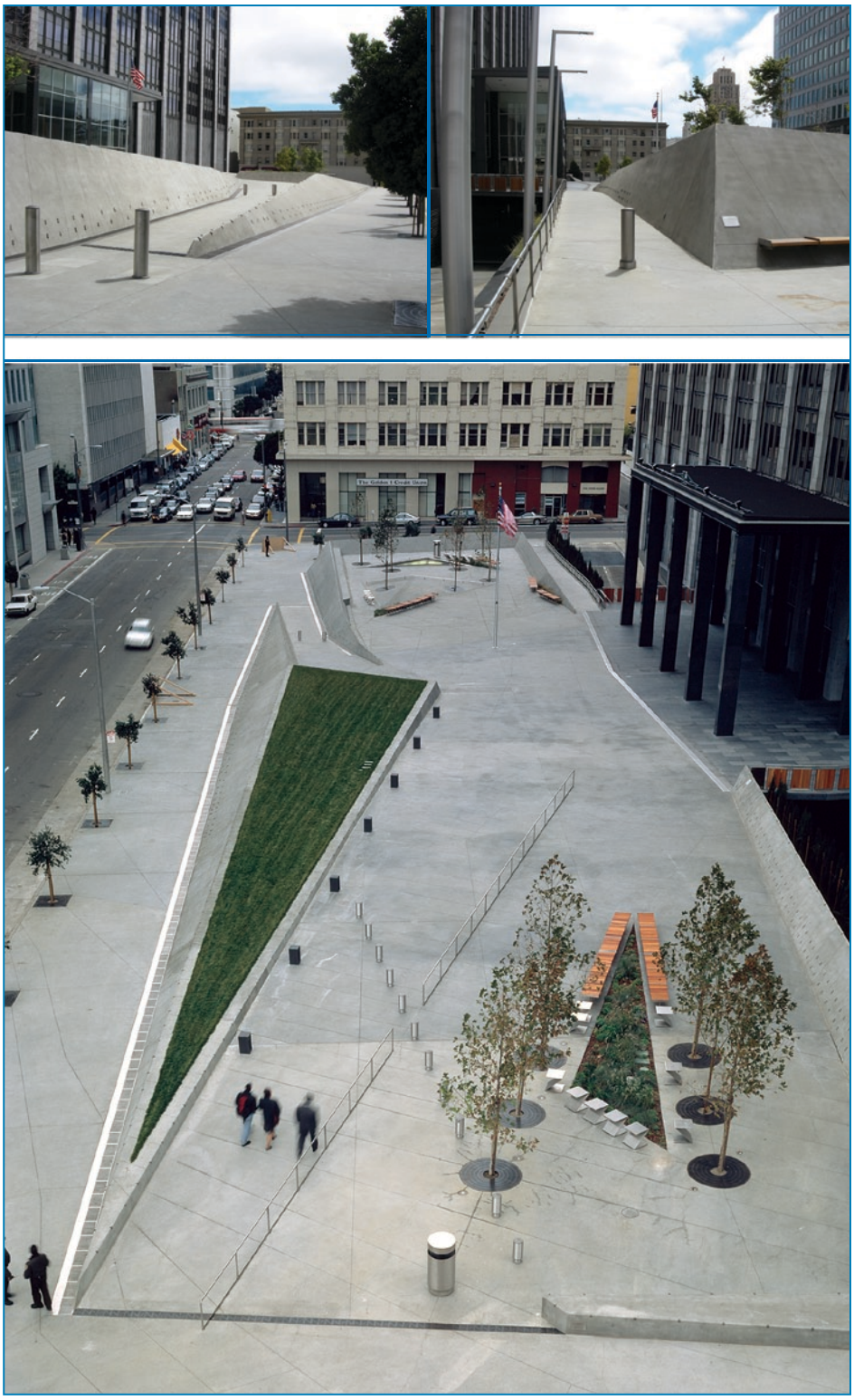


Figure 6-17:
Sculptured forms, streetscape elements, and custom-designed bollards used as barriers at the San Francisco Federal Building.

SOURCE: DELLA VALLE + BERNHEIMER ARCHITECTS/AERIAL PHOTO: RICHARD BARNES

On the existing plaza shown in Figure 6-17, the barriers are sculptured objects that make the plaza almost impenetrable for a vehicle and, combined with landscape features such as plants, pools, and seating, make the plaza a much more interesting place than it was prior to the security retrofit.

Figure 6-18 shows a plaza with a variety of landscape features, including tree planting, that contribute to a second layer of defense and also create an attractive setting for the building.

A perimeter of sweet gum trees, concrete benches, and stainless steel bollards forms the first line of defense. Should a driver smash a car through those, it would be necessary for the car to cross a water lily pond that doubles as a security moat, or navigate through a grove of 80 trees carefully staggered to prevent a vehicle from getting a clear shot at the main entrance. After those obstacles, a sunken sculpture garden, designed both to please the eye and trap a vehicle in the soft grass, sits directly outside the building staircases. Even the building's sign is part of the security system: twenty feet long, made of stone, it forms part of the western perimeter. If a vehicle made it through all of these, it would still have to climb 18 feet of steps.

Figure 6-18: Overhead view of plaza, Seattle Court House.

SOURCE: PETER WALKER AND PARTNERS

The plaza in Figures 6-18 and 6-19 are situated on a steeply sloping street: a high set of steps acts as a barrier, and within the plaza, a water feature contributes to a second line of defense by increasing stand-off (Figure 6-19)

Figure 6-19: Steep flight of steps and water feature acting as barriers.

SOURCE: PETER WALKER AND PARTNERS

The plaza in Minneapolis shown below is located between the City Hall and a new federal courthouse. The entire plaza is built on a parking garage roof. The design refers to Minnesota's cultural and natural history; earth mounds and logs, elements of that history, are the plaza's symbolic and sculptural elements. An earth mound is also almost impossible to drive over, but if anyone manages to surmount it, the mound will collapse into a void below. The huge logs also limit the possibility of direct vehicular access to the building (Figures 6-20 through 6-23).

Figure 6-20: Minneapolis courthouse plaza on a garage roof with planted berms and log benches that symbolize Minnesota's history.

SOURCE: COURTESY OF MARTHA SCHWARTZ, INC.

Figure 6-21: Minneapolis Courthouse plaza with planted berms, representing historic Minnesota "drumlins." They also act as barriers to a vehicular attack, as a second layer of defense, creating stand-off.

SOURCE: COURTESY OF MARTHA SCHWARTZ, INC.

Figure 6-22: Minneapolis Courthouse plaza: detail of drumlin and logs. The logs serve as seating.

SOURCE: COURTESY OF MARTHA SCHWARTZ, INC.

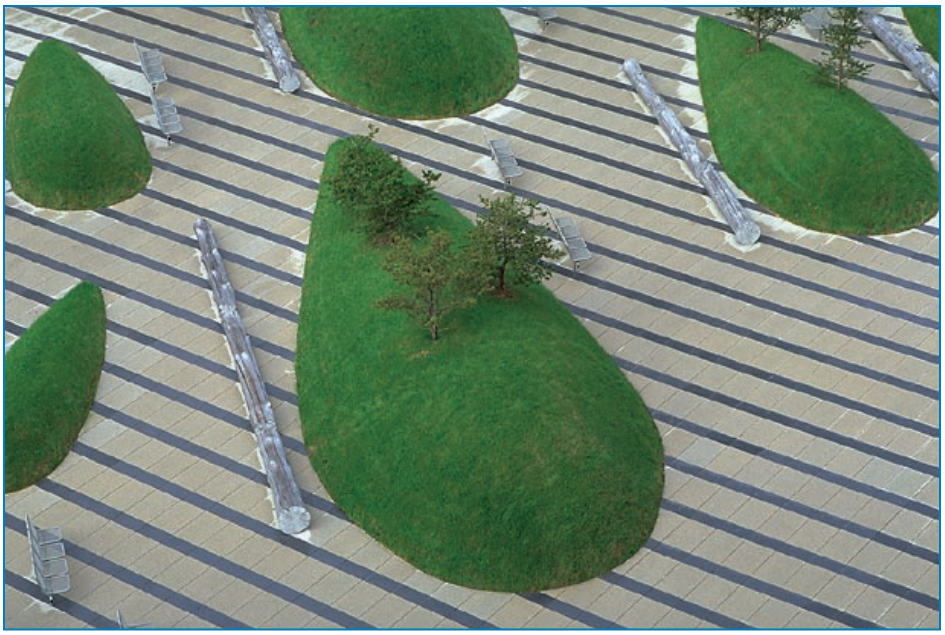


Figure 6-23:
Drumlin direction and plaza paving pattern lead pedestrians towards building entrance.

SOURCE: COURTESY OF MARTHA SCHWARTZ, INC.

6.5 ACCESS POINTS

Security may prevent normal through-site access. Vehicles may be used to carry explosives and CBR material near or into a facility. A terrorist vehicle bomb driven near or into the building, or a hand-carried bomb placed close to the building, can severely injure people and damage structures. In case a barrier or control booth is necessary, they need to be carefully designed to reduce their visual impact. Too many entrances can stretch security forces thin and/or increase the expense of security force and equipment cost in controlling access.

For high-risk facilities and heightened threat levels, it is important to screen visitors and/or staff for weapons and explosives. Screening may include visual inspection, baggage search, walk through, hand-held metal detectors, x-ray inspection machines, explosives detectors, and chemical and biological agent detectors. If screening equipment is required, appropriate space should be allocated early in the design or retrofit planning phases. This space should be carefully designed according to the type of security required, the anticipated number of visitors, and the number of security personnel. Large accumulations of people at the entrance of a building should be avoided, since crowded conditions can conceal covert activity, such as the placement of a hand-carried bomb.

An adequate number of security personnel and sufficient inspection equipment should be provided to facilitate rapid processing of visitors and staff, especially at the opening of business, lunchtime, and close of

business. Long queues can result in a tendency to hurry the screening process, which might provide an opportunity for unauthorized access for people and weapons. If there is sufficient space inside the entrance of the building, queuing will occur within the building footprint. If there is insufficient space inside the entrance, queuing should be expected outside the building, and a rain cover should be provided.

Figure 6-24 shows a well-designed vehicle entrance. This combines a simple gatehouse and building sign with a graceful arched protective roof.

Figure 6-24: Pedestrian entry has new gates designed in keeping with the historic fence (top). A graceful arched canopy and elegant guard house provide vehicular entry control

SOURCE: NCPC

6.6 INTERMODAL SYSTEMS

Typically, urban sites with access to nearby transit, bus lines, rail, and other modes of transportation should be carefully evaluated for security and circulation impacts. Staff and visitors require convenient access to the stations and stops, which may conflict with stand-off and site access needs. The design of walkways, bus stops, drop off zones, and parking areas should balance functionality with security requirements of the project for stand-off distance, accessibility control, screening, and control of views. In some instances, subway stations can be entered directly from a building or the street entry leads both to the building and a subway station. Inter modal hubs are shown in Figures 6-25 and 6-26.

Figure 6-25:
Large intermodal hub with parking, main railroad, subway, and buses.

SOURCE: GOOGLE EARTH, MODIFIED

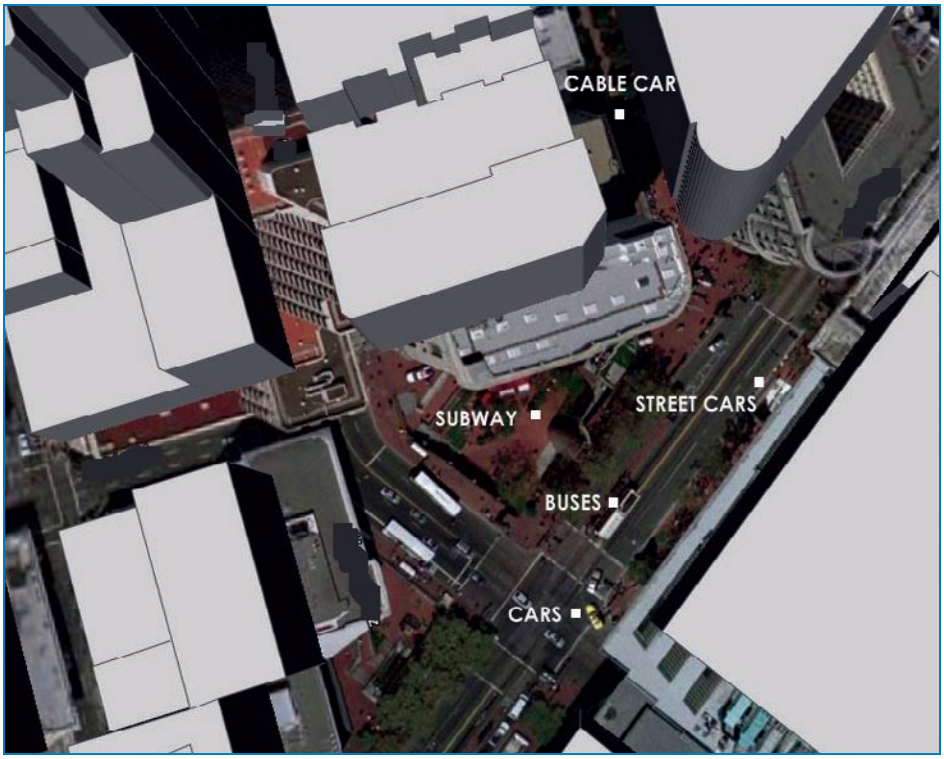


Figure 6-26:
Urban intermodal hub. aerial view, left. An entry that serves both as a subway and building access is shown, right.

SOURCE: GOOGLE EARTH, MODIFIED, LEFT.

Some considerations for minimizing the impact of security measures in the vicinity of intermodal hubs are:

- Exploring ways to mitigate impacts of security improvements that restrict access to or use of subways and railroads by regular users.

- Studying locations for security improvements and alternatives for circulation paths that mitigate impacts on existing circulation routes to stations, bus stops, etc.
- Designing for the appropriate level of security based on the design basis threats, and increasing controls by planned temporary means if the threat level increases.
- Understanding the community impact of developing perimeter security and devising potential mitigation strategies to preserve local mobility and connectivity.
- The need for special protective measures at bus stops and other drop-off and pick-up areas (Figure 6-27).

Figure 6-27:
Bus stops and other drop-off and pick-up areas may need special protective measures.

6.7 PARKING

6.7.1 INTRODUCTION

Typical parking in the central business district includes public on-street parking lanes, underground parking beneath plazas or other public spaces, parking beneath buildings, and freestanding or attached parking structures.

Surface parking lots are often congested and temporary, awaiting development. Mitigating the risks associated with parking requires selection of a coherent set of design measures, including parking restrictions, perimeter buffer zones, barriers, structural hardening, and other architectural and engi-neering solutions (Figure 6-28).

Figure 6-28: Parking control and restriction is a typical aspect of the urban scene.

Parking layouts should be carefully designed to reduce risk. The layout of circulation aisles should prevent vehicles from driving directly towards a building from the parking lot. The layouts of the parking bays, as well as the use of berms, barriers, and screening are all effective ways to prevent this. The same strategy can also serve an aesthetic purpose by minimizing the visual impact of the parking area from other points of the site.

If areas previously used for parking are to be discontinued due to security requirements, an alternate treatment should be developed, so that abandoned, untended parking areas do not become accessible to potential attackers.

6.7.2 PUBLIC STREET PARKING

Public street parking is often located within a desired stand-off zone. To increase stand-off it may be proposed that the parking lane be closed. Evaluation of the viability of this option must consider the role of the street within the local infrastructure, and whether an additional lane provides significant improvements of the stand-off distance.

If street parking lanes are unacceptable because of the high risk, access to the vulnerable streets and parking may have to be prohibited to create an adequate stand-off zone. This approach has been adopted in the New York City Financial District.

Considerations for public street parking include:

- Request appropriate permits to restrict parking in curb lanes in densely populated areas to company-owned vehicles or key employee vehicles.

- The impact on local businesses due to loss of on- street parking should be evaluated.

- Provide appropriate setback from parking on adjacent properties, if possible. Structural hardening and/or enhanced surveillance methods may be required if the setback is insufficient. In new designs, it may be possible to adjust the location of the building on the site to provide adequate setback from adjacent properties.

- Pick-up and drop-off areas should have appropriate barriers at the edge of the curb to enforce stand-off distances for unscreened vehicles and to address mobility and convenience for pedestrians. This includes placement of barriers at a distance from the curb to allow clearance for vehicle doors to open, provision of adequate lighting and shelter so pedestrians can wait safely for their rides, and appropriate design for handicapped access. Circulation planning should make sure that effective access is available for first responders and other emergency vehicles (Figure 6-29).

Figure 6-29:
Lengthy shelter for curb lane drop-off and pick-up area.

SOURCE: NYPD

The following sections offer security design guidance for the layout and design of public on-street parking lanes, underground parking, and parking within buildings.

6.7.3 UNDERGROUND PARKING AND PARKING BENEATH BUILDINGS

Buildings adjacent to underground parking may suffer collateral damage in the event of an explosion within the garage. This risk must be evaluated to determine the level of inspection and control at the entry. Typically, this would be limited to fee taking and cursory inspection, but for a high-risk building or a heightened condition of security, careful security inspection may be necessary on a temporary basis.

Protection of primary vertical load-carrying members by designing architectural or structural features that can keep an explosive even a few feet away can make a big difference. For portable devices, a few inches or a couple of feet may be critical. Emplacing sloped features or other simple designs around accessible portions of columns are simple measures that may prevent a column collapse, and parking design may also be used to keep vehicles a few feet away from columns. These are simple, cost-effective measures that can minimize risk of collapse and still be unobtrusive or even attractive.

Typical entry control to protect underground parking beneath high-risk buildings is shown in Figures 6-30 and 6-31.

Figure 6-30:
Entry control to underground garage. Note provision for queuing and gatehouse design in harmony with the building. Careful design of all the needed components is necessary to avoid clutter. If possible, such entry control is best located on an access road or service alley rather than a public street

Figure 6-31:
View from a public street of entry control for underground parking at a court house. The entry is used for prisoner delivery and limited parking controls. Elimination of temporary signs and posts might reduce the clutter.

If parking beneath a high-risk building must be provided, access to the parking area should be controlled and limited, and spaces should be well-lighted and free of places of concealment and dead-end parking spaces. The following restrictions may need to be applied:

- Public parking with ID check.
- Company vehicles and employees of the building only.
- Selected company employees only, or those requiring security.

The designers needs to consider the following:

- For all stand-alone, above-ground parking garages, maximize visibility for surveillance into, out of, and across the garage.
- Employ express or non-parking ramps, sending the user to parking on flat surfaces.
- Stairways and elevator lobby design should be 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. Designs that ensure that people using these areas can be easily seen (and can see out) should be encouraged. If a stair must be enclosed for code or weather protection purposes, glass walls can be used to deter potential attacks. Potential hiding places below stairs and within and around stairwells should be closed off.

- Elevator cabs should have glass backs whenever possible. Elevator lobbies should be well-lighted and visible to both patrons in the parking areas and the people outside the building.

- Pedestrian paths should be designed to concentrate activity to the extent possible. For example, bringing all pedestrians through one portal rather than allowing them to disperse to numerous access points improves their ability to see and be seen by other users. Limiting vehicular entry/exits to a minimum number of locations is also beneficial.

- Parking structures open to the public should be sited and evaluated with concern for stand-off from other buildings and screening from critical operations and sensitive areas that might be observed from within the parking structure and used as a point of access or staging for use of weapons or explosives.

- Urban parking structures are likely to have high volumes of pedestrians and vehicles to accommodate, may be connected by bridges to nearby building, and may provide high vista points for surveillance or threat to adjacent buildings.

- In the design of parking structures that include screening or inspection, consider locating these functions outside, at adequate stand-off distances, to control impact from explosions. Adequate space should be provided for queuing and inspection, so as not to slow traffic in and out of the garage (Figure 6-32).

Figure 6-32: Queuing and inspection outside an entry to parking beneath a building.

- When establishing parking areas, provide emergency communication systems (e.g., intercom, telephones, etc.) at readily identified, well-lighted, closed-circuit television-monitored locations to permit direct contact with security personnel.

- Provide parking areas with closed-circuit television cameras connected to the security system and adequate lighting capable of displaying and videotaping area activity.

- Designing for internal vehicular and pedestrian connections from parking garages to nearby buildings is similar to that for surface parking areas.

6.8 LOADING DOCKS AND SERVICE AREAS

Loading docks and service areas should be sited so that they are easily accessible for trash storage and pickup and service and deliveries by trucks (including large semi-trucks if the project requires it). Loading areas should be sited so that they can be screened from most roadways and sidewalks. They should be located close to mailrooms and freight elevators wherever possible.

Due to the possibility of bombs, chemical, biological, and other types of threats arriving at these locations, many organizations have chosen to relocate their loading and delivery functions to an off-site location or a remote area of the site. Others have chosen to harden these areas so they can contain explosions and protect adjacent areas of the building. For these reasons, siting and layout of loading areas should accommodate sufficient area for screening vehicles and packages. If possible, screening should be off site and scheduled deliveries required. This may be difficult to achieve in a tight urban site (Figure 6-33). For more information, refer to *FEMA 426*, Section 2.8.

Figure 6-33:
Screening areas need sufficient space. This loading area is immediately adjacent to a public sidewalk. When two or more vehicles are stopped, pedestrian activities can be disrupted, and risk to passersby is increased.

SOURCE: FEMA E155

Design considerations for loading docks and service access include the following:

- Separate (by at least 50 feet) loading docks and shipping and receiving areas in any direction from utility rooms, utility mains, and service entrances, including electrical, telephone/data, fire detection/alarm systems, fire suppression water mains, cooling and heating mains, etc.

- If possible, avoid having driveways within or under buildings. If necessary, monitor them and restrict height to keep out large vehicles.

- Significant structural damage to the walls and ceiling of the loading dock may be tolerable, as long as the areas adjacent to the loading dock do not experience severe structural damage or collapse. This can be achieved by an adequate structural design that limits damage to the loading dock area and allows explosive forces to vent to the building exterior. The floor of the loading dock does not need to be designed for blast resistance if the area below is not occupied and/or does not contain critical utilities.

- Provide signage to clearly mark separate entrances for deliveries.

- The loading zone should be designed for effective observation by cameras or guards. The design of planting areas, walls, and steps, and the selection of plants and street furniture should allow easy observation of the space and avoid areas where packages might be hidden.

6.9 PHYSICAL SECURITY LIGHTING

Adequate lighting should be provided to aid in threat detection; this also assists in providing a defensible space for pedestrians. Site lighting is an integral component of the site design, with several functions (Figure 6-34):

- To extend the hours of use into the early morning and evening by illuminating entries, walkways, signage, and roadways.
- To improve security and provide enhanced visibility.
- To add beauty by illuminating architectural details, landscape areas, specimen plants, outdoor artwork, and other features.

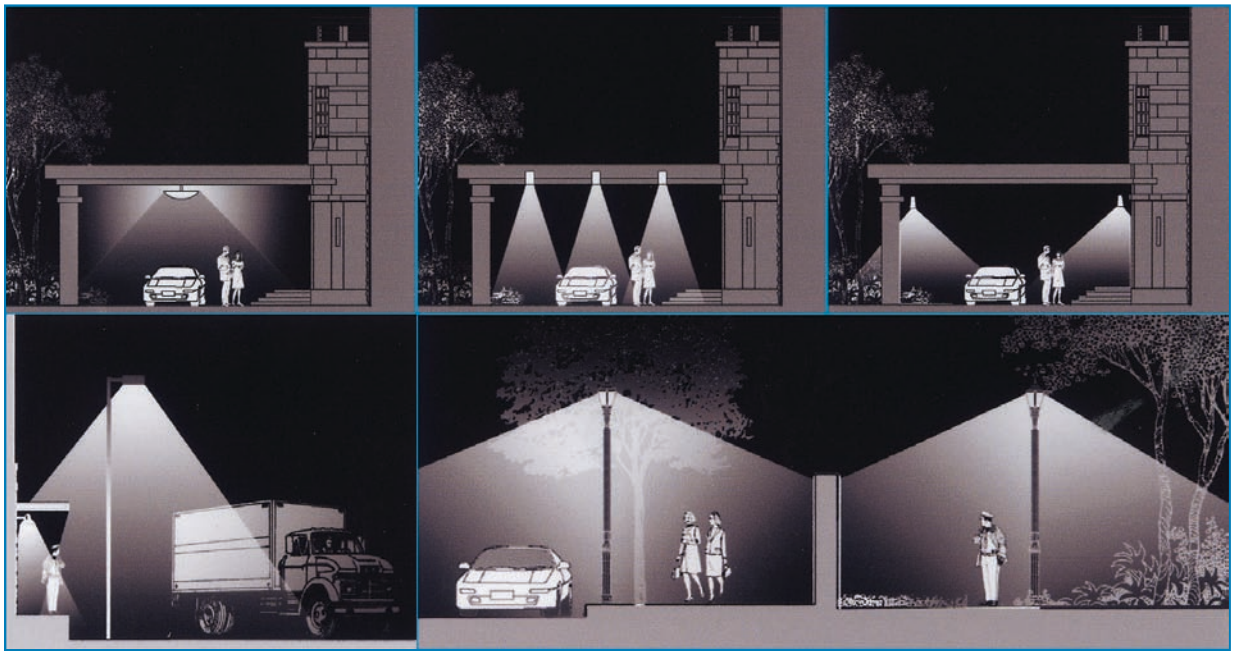


Figure 6-34: Appropriate lighting for a variety of situations.

SOURCE: DEPARTMENT OF STATE

A successful site design will consider appropriate types and light levels for:

- Emergency lighting as part of emergency backup systems (Refer to *FEMA 426*, Section 2.9, for more information about these four types of site lighting).
- Entry points (e.g., site entry points and building ingress and egress).
- Circulation (e.g., roadways, parking areas, sidewalks, and walkways).

- Street and perimeter lighting.
- Signage illumination.
- Decorative landscape lighting.
- Security lighting.

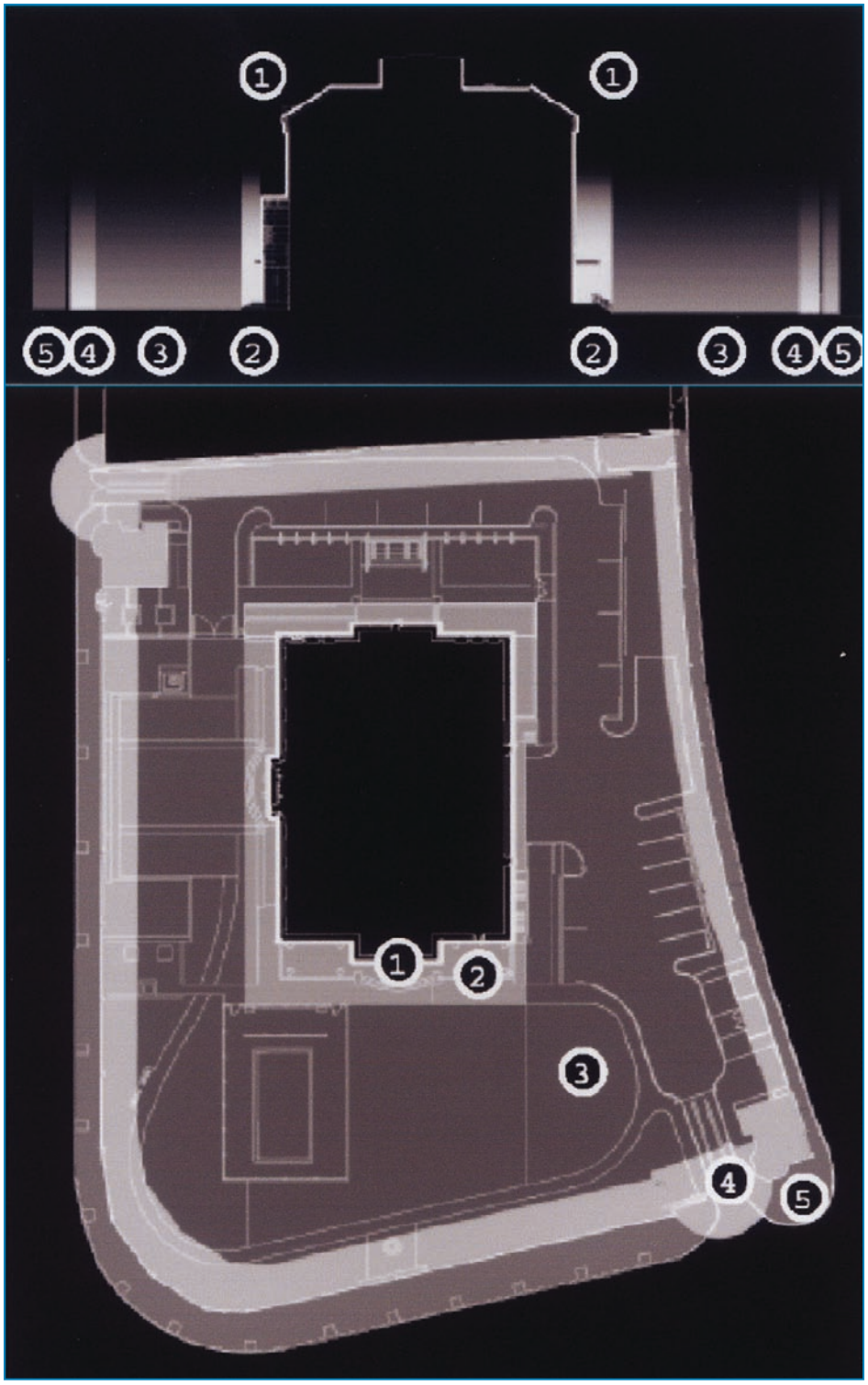
Site lighting can be separated into zones in order to concentrate light where it is needed most. Prioritizing will allow for the most efficient use of lighting, while keeping within a reasonable budget. Figure 6-35 shows some typical zones; the numbers on the figures refer to the descriptions below.

1. Exterior surface of building, including walls, doors, windows, rooftop terraces, and balconies.
2. Outdoor areas directly associated with entryways to building, including walkways, steps, ramps, terraces, and loading docks.
3. Intermediate outdoor areas, including driveways and parking; walkways and paved terraces; small gardens and large, remote landscaped areas; recreational facilities; and utility, service, and storage areas.
4. Areas immediately inside the perimeter, including inside faces of walls and required clearances; pedestrian entryways, vehicular entryways, and security check points.
5. Areas outside the perimeter that may be considered defensible space, including public sidewalks and streets, waterways, and adjacent non-public properties.

It is also important to consider operational costs when designing an appropriate lighting situation.

- Estimate and evaluate the lifecycle costs for energy and maintenance.
- Evaluate the impact on project sustainability.

In addition, site lighting can be helpful as a response to different levels of alert, by designing it to be increased in times of high security alert. Provision of additional light is a common CPTED technique to discourage unwanted activities on sites and within buildings and to enhance desirable activities (Figure 6-36).



Figures 6-35:
Site lighting zones.

SOURCE: DEPARTMENT OF STATE

Figure 6-36:
Night view of government building approach and screening structure.

6.10 INFRASTRUCTURE AND SITE UTILITIES

In-ground infrastructure can be any of the following:

- Standard utility lifelines such as water, gas, steam, sewer, storm water, electric communications, etc.
- Any structure that can be used by persons, such as subway tunnels, stations, large sewer or water tunnels, or pipes.
- Ventilation shafts supplying either the building or the in-ground infrastructure.

In the urban situation, it may be necessary, because of the limited space, to place vehicle barriers on yards, sidewalks, or plazas that are located over a dense infrastructure of all kinds of utilities, some of which may have been in existence for decades. There may be conflicts below grade, as an increasing number of current and past utility systems compete for limited space. Determination of the materials, size, and location, both horizontal and vertical, of these utilities is critical, because their interaction with barrier foundations may create costly or even impractical conditions; the location of barriers may be strongly influenced by the utility pattern. In addition, subway stations, public parking structures, and utility tunnels may have direct access to areas adjacent to building utility systems.

Unlike an open site, in-ground utilities connect to the building directly from the municipal services. Thus the primary concern of the property owner is that of the security of this connection and any necessary openings into the building.

Failure of part of the in-ground infrastructure may affect the structural system of the building. When the infrastructure and the building are in close proximity or rigidly linked, the failure of one system may initiate failure of the other. The part of the structure closest to the in-ground infrastructure is the most vulnerable. It should be hardened so that any local failure would not initiate progressive collapse in the rest of the building. Aside from hardening, other measures available are increased ductility, increased setback, or better access control.

In a zero setback situation in-ground utility systems and other lifelines will be under public property and not under the building owner's control. Coordination with the public agencies will be necessary to ensure protection to the systems so that the building functions will not be affected by damage to the municipal utilities and infrastructure.

In the case of a building located on a large plaza, critical utilities my be located on the owner's property. and their protective design may be part of the project scope. Some issues related to urban site utilities and infrastructure are:

- Based upon the size of the lifeline, such as a large sewer system, access to the site or building may be possible and, based on the size of the utility service entrance to the building, personnel or CBR agents may be able to enter the building.

- In-ground infrastructure and the building can be connected by passageways, subways, tunnels, connecting stairways, entrance/exit portals, and ventilation shafts, as well as by direct utility connections from utility lifelines.

- Lifeline attachment to a building should be sealed to prevent infiltration of CBR and large entrances secured to prevent personnel access.

- Redundant sources of supply and any on-site storage needs, e.g., water storage (for domestic and industrial use or fire suppression), fuel storage, and on-site generators, should be identified. Each utility system's requirements for siting, redundancy, and safety should be addressed.

- Plans for installation and modification of utilities for security purposes should be coordinated with local municipalities and/or service suppliers.

Utility systems can suffer significant damage when subjected to the shock of an explosion. Some of these utilities may be critical for safely evacuating people from the building. Their destruction could cause damage that is disproportionate to other building damage resulting from an explosion. To minimize the possibility of such hazards, apply the following measures, where appropriate:

- Ensure that access to crawl spaces, utility tunnels, and other means of under building access is controlled in order to limit opportunities for aggressors to place explosives underneath buildings. All utility penetrations of a site's perimeter barrier should be sealed or secured to eliminate openings large enough for persons to pass through the barrier. Typical penetrations could be for storm sewers, water, electricity, or other site utility services.

- If access is required for maintenance of utilities, all penetrations should be secured with screening, grating, latticework, or other similar devices so that openings do not allow intruder access. Provide intrusion detection sensors, and consider overt or covert visual surveillance systems, if warranted by the sensitivity of assets requiring protection.

- Protect vents, ducts, and other openings that pass through a perimeter and that have a cross-sectional area greater than 96 square inches, and whose smallest dimension is greater than 6 inches, by securely fastened welded bar grilles.

- Consider quick connects for portable utility backup systems if redundant sources are not available.

- Prepare vulnerability assessments for all utility services to the site, including all utility lines, storm sewers, gas transmission lines, electricity transmission lines, and other utilities that may cross the site perimeter.

- Provide utility systems that support site security, life safety, and rescue functions with redundant or loop service, particularly in the case of electrical systems. Where more than one source or service is not currently available, provisions should be made for future connections.

- The choice of cover materials in sidewalks and other pedestrian areas should enable ease of access to utilities for repair and maintenance, but limit access by terrorists or vandals. Attractive paving that is easily removed and replaced can be substituted for standard concrete sidewalks that have to be torn up and patched (Figure 6-41).

Figure 6-37: Sidewalk paving with removable panels eases maintenance of underground utilities.

6.11 CONCLUSION

Protection of sites in an urban environment presents particular difficulties; desired stand-off is unobtainable, road patterns are fixed, and road closures can be extremely disruptive. It may be necessary to accept a higher level of risk. This may be partially offset by the facts of urban congestion that may block the terrorist from making a high speed head-on attack on a building.

The possibility of an attacker parking, even briefly, adjacent to a target building, however, is an ever-present threat. This underscores the need for protective measures applied to the building exterior and possible re-programming to remove critical assets from the lower floors adjacent to the street. A common offset, however, is that many downtown buildings, particularly those constructed before World War II, are very solidly built, with concrete-encased steel frames, short structural spans, and small window openings. These types of buildings have been found to be very resistant to collapse.

The protective measures applied to the New York City Financial District, described in Case Study 6, show that a coherent and imaginative approach to the problem can achieve urban enhancement, even when street closings are necessary to achieve acceptable stand-off from high-risk targets. The exciting quality of the environment is maintained, new public space is created, and the rich history of the location is reflected in the nature and placement of contemporary protective installations.