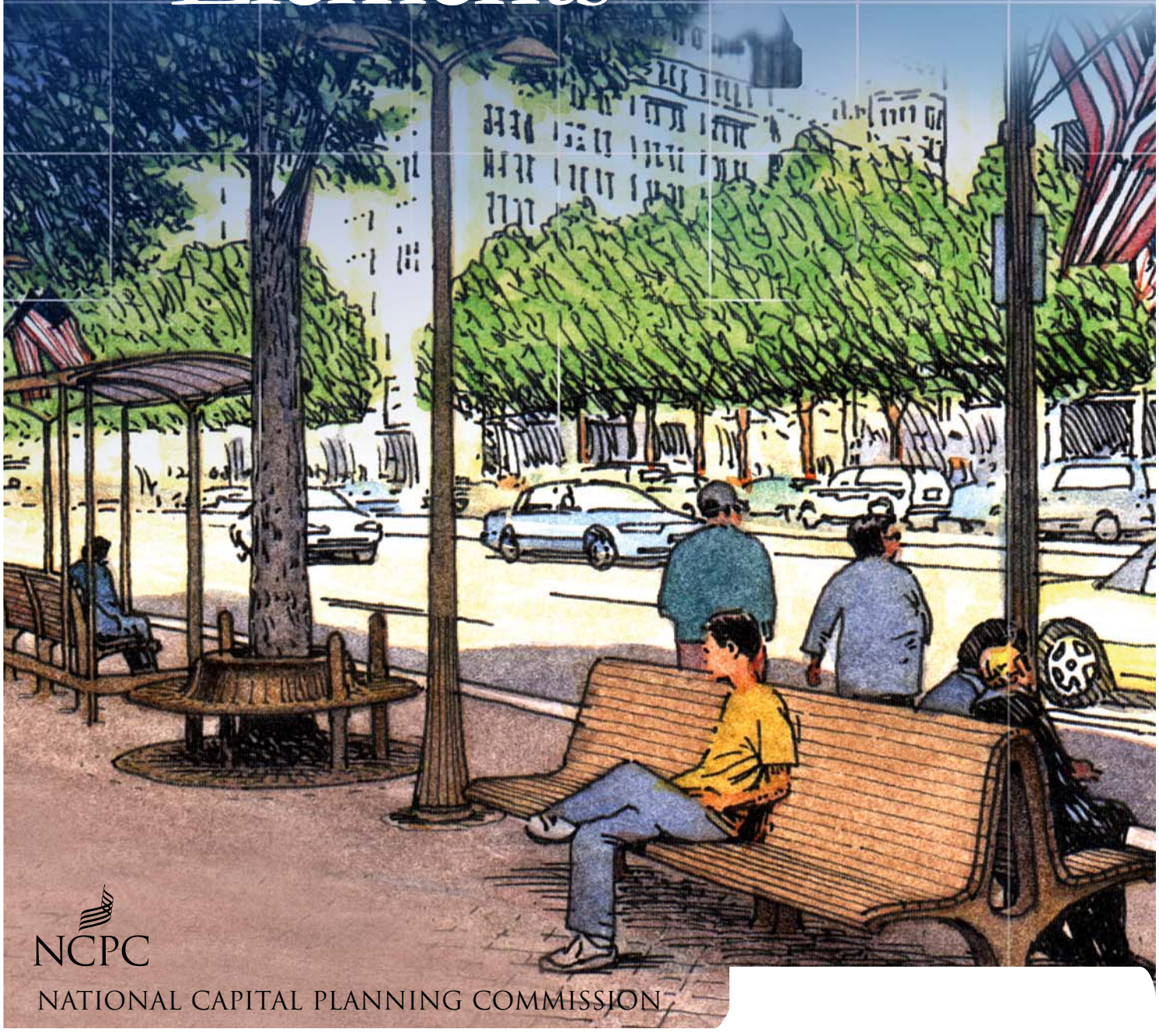
The National Capital Urban Design and Security Plan

Designing *and* Testing *of* Perimeter Security Elements



NCPC

NATIONAL CAPITAL PLANNING COMMISSION

Poorly designed security measures negatively impact Washington's dramatic views, gracious open spaces, and historic urban design.

NCPC

The **National Capital Planning Commission** is the federal government's planning agency in the District of Columbia and surrounding counties in Maryland and Virginia. The Commission provides overall planning guidance for federal land and buildings in the region. It also reviews the design of federal construction projects, oversees long-range planning for future development, and monitors capital investment by federal agencies.

Designing *and* Testing *of* Perimeter Security Elements

Introduction

The National Capital Planning Commission (NCPC) is the central planning agency for the federal government in the National Capital Region. One of its primary responsibilities is to review federal development projects, including perimeter security designs for federal buildings. Such a project typically involves the installation of barriers around a facility's perimeter in order to prevent vehicles from reaching the structure or a sensitive space on the grounds of the facility.

Within the last decade, security barriers have become common features surrounding federal buildings in Washington, D.C. This was provoked by vehicle bombings in the 1990s at the Alfred P. Murrah Federal Building in Oklahoma City and at U.S. embassies overseas. Further terrorist incidents—the 9/11 attacks on New York and Washington and train bombings in Madrid and London—have intensified the demand for security solutions.

While protecting important public and private buildings is a legitimate need in the United States, that need has too often been dealt with by the placement of unsightly barriers that detract from the public space and create a fortified atmosphere. A major challenge that planners and designers in Washington face today is to develop effective perimeter security measures that respect existing dramatic views, gracious open spaces, and the city's historic urban design.

Designing *and* Testing *of* Perimeter Security Elements

The National Capital Urban Design and Security Plan

The Interagency Security Task Force

The National Capital Planning Commission began to address the issue of security design in March 2001. Through an Interagency Security Task Force, NCPC issued a report in October 2001—*Designing for Security in the Nation's Capital*—to recommend specific urban design strategies for improving aesthetic conditions and access to public space in Washington. One of the key recommendations of this report was to develop a comprehensive plan to guide federal agencies in designing attractive security solutions. The effort was initiated in January 2000, in consultation with more than 75 departments and organizations representing the federal and local governments, civic and business groups, the professional design community, and the public. NCPC released the *National Capital Urban Design and Security Plan* in October 2002.

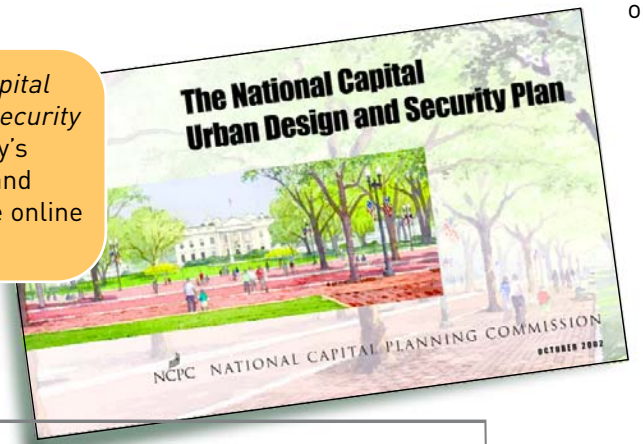
The plan proposes an expanded palette of attractive furnishings and landscape solutions to guard against the threat posed by bomb-laden vehicles while preserving the open space qualities of the capital's urban design. Built on an urban design framework that identifies key areas and streets within Washington's monumental core, the Plan recommends security solutions that respond to the unique conditions and special character of each precinct.

In some cases, the best solution is to harden furniture that would typically be installed along a streetscape. Benches, bus shelters, and newspaper kiosks are just a few of the elements that could also serve as vehicle barriers if properly engineered. In other instances, security elements—such as low plinth walls, planters, and curbside hedges with embedded security—could be custom-designed in accordance with surrounding architecture.

While the plan focuses on security solutions for Washington, D.C., the design philosophy can be adapted to almost any urban environment.

To advance the goals established in the *National Capital Urban Design and Security Plan*, NCPC adopted objectives and policies in May 2005. These policies provide detailed guidance on the placement and design of perimeter security barriers while encouraging a multi-faceted approach to security measures. This approach should consider intelligence information about political threats, operational and procedural measures (such as surveillance and screening), and design strategies (such as structural engineering, window glazing, emergency egress, and physical perimeter barriers). NCPC's security design objectives and policies also reinforce the intent of the agency's security plan to balance the need for perimeter security with the need to make public space open, accessible, and attractive.

NCPC's *National Capital Urban Design and Security Plan,* and the agency's security objectives and polices are available online at www.ncpc.gov



Security Element Design

In developing security design solutions, the plan recognizes that one size does not fit all. Landscape architects, architects, and urban designers should be consulted during the design development of streetscape elements to ensure that a scheme is appropriate to the setting and security needs of a specific building or site. The physical elements described in this section can be designed to both enhance streetscapes and serve as vehicle barriers.

WALLS, TERRACES, AND RAISED PLANTING BEDS

- Walls prevent vehicles from approaching buildings and can be established at the property line on the building side of the sidewalk.
- Terraces are flat or stepped areas—usually paved—that surround buildings.
- Raised planting beds are generally extensions of the building's first-floor elevation into the building yard.

TREES AND PLANTERS

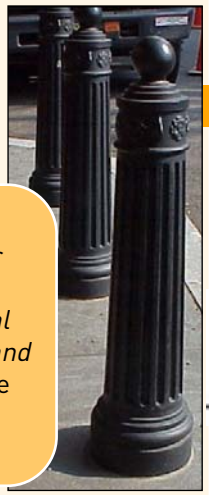
- Trees can be used as obstacles to block access of an approaching vehicle.
- Barriers can be embedded in a hedge which can be coordinated with other landscape features to form a unified streetscape.

KNEE WALLS AND FENCING

- Mostly found in the building yard as a complement to the structure's architecture, small knee walls are often located in conjunction with planters and gardens.
- Decorative fencing and ironwork can be strengthened to meet security requirements.

GATEHOUSES

- Gatehouses, which are separate structures located close to buildings, provide shelter for individuals who screen vehicles accessing pick-up, drop-off, or parking areas.

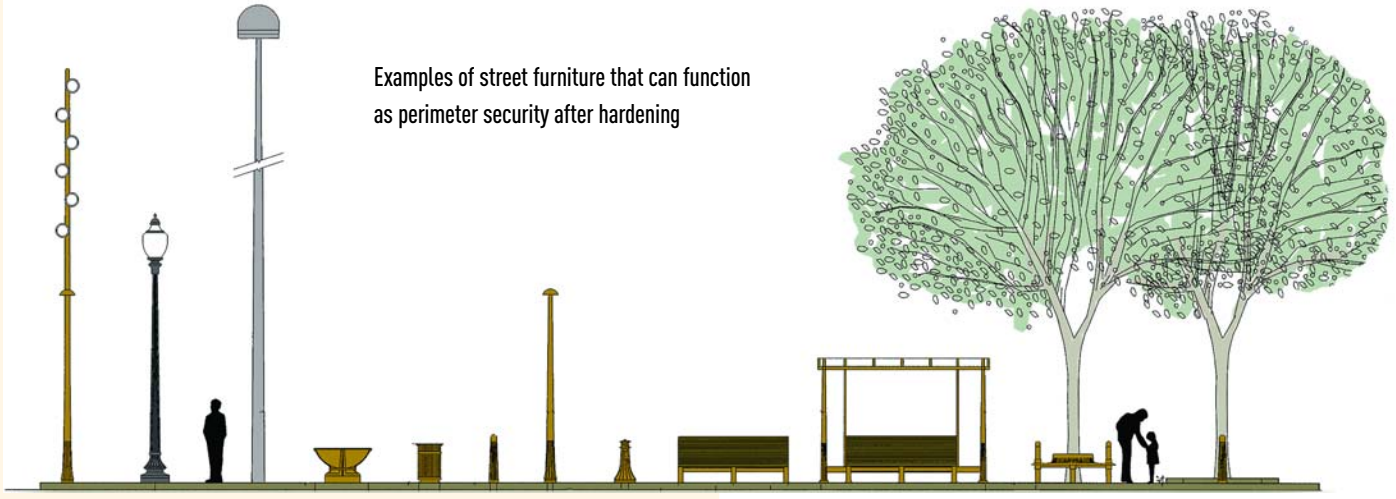


BOLLARDS

- Curbside bollards can provide security against vehicular attacks. Through careful design and placement, bollards can guide pedestrian circulation, meet accessibility requirements, and enhance the character of the streetscape.

Further guidance on appropriate designs for security elements is provided in the *National Capital Urban Design and Security Plan* and in the agency's security objectives and policies.

Examples of street furniture that can function as perimeter security after hardening



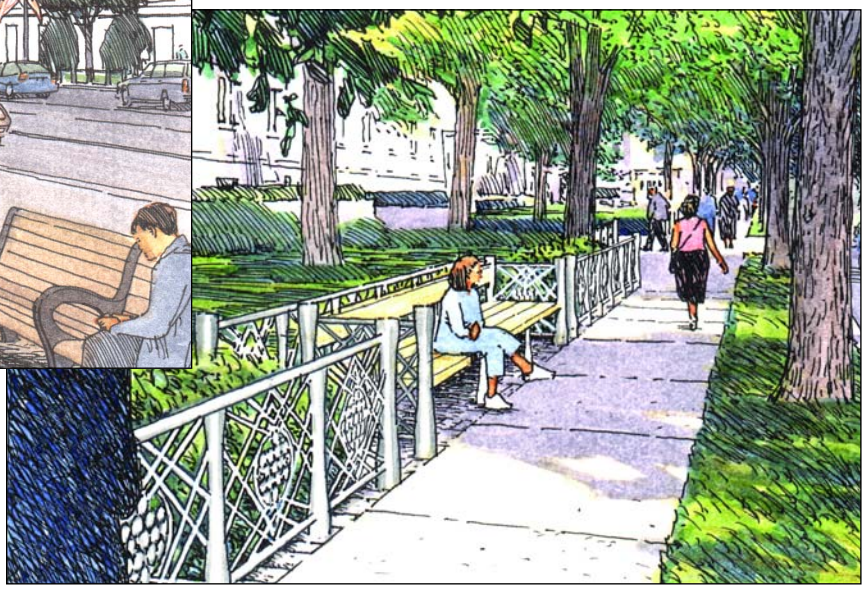
Thinking Contextually

The context of the surrounding streetscape should be considered when designing security measures. Security components can include a wide range of elements beyond walls, planters, and bollards. Through proper design and engineering, a variety of attractive elements and landscape features can serve as anti-ram barriers to stop a moving vehicle. Such elements should foster a sense of openness by allowing for easy pedestrian and bicycle access.

NCPC's *National Capital Urban Design and Security Plan* encourages designers to consider how ordinary street furniture can be hardened to provide effective security. Utilizing elements typically found along a streetscape—e.g., benches, lampposts, drinking fountains—helps to prevent clutter and make security appear seamless.

Hardening these elements can be as simple as incorporating vehicle anti-ram barriers with decorative sleeves. Items such as newspaper stands, bus shelters, and lampposts can all be designed with sleeves that fit over reinforced bollards or posts to stop a moving vehicle. Bike racks, benches, and drinking fountains also have the potential to serve as perimeter security.

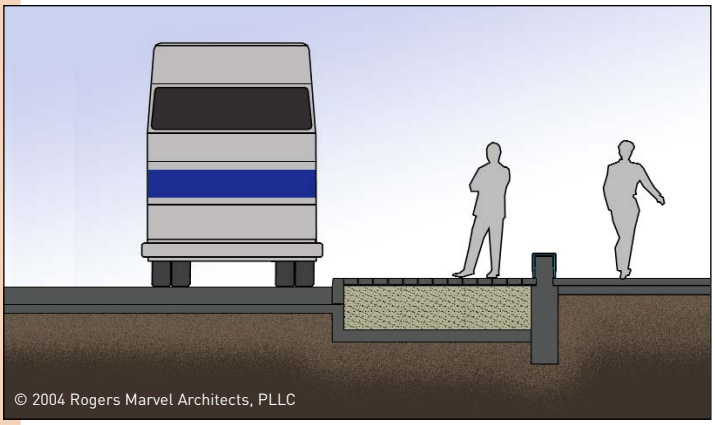
Once these streetscape components are designed and tested, designers will be able to develop security schemes from an expanded palette of components. Having more options should help designers balance security needs with the desire to maintain beautiful and accessible streetscapes.

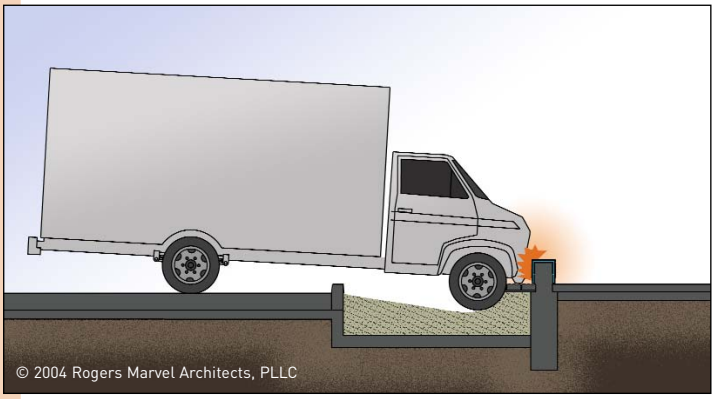


Hardening typical streetscape elements, such as benches can foster seamless security.

Creative Solution

New York City-based Rogers Marvel Architects and Rock Twelve Security Architecture have developed a creative solution for providing security without introducing barriers into the landscape. The solution, called the *Tiger Trap™* system, consists of material placed under the surface of a building's perimeter. The material is strong enough to hold foot traffic, bicycles, and other items that are common to the use of public space. However, if a vehicle were to drive on the surface, it would collapse into the material below and be immobilized. This solution maintains open public space for pedestrian traffic and disguises a barrier that is capable of halting an approaching vehicle. Further, the Tiger Trap™ system was successfully tested at the U.S. Army Corps of Engineers facility in Vicksburg, Mississippi, where the system stopped a 15,000-pound truck traveling at 50 mph. This approach is now being planned for use in New York City's dense urban environment.





A vehicle can be immobilized by the collapsible material of the Tiger Trap™ system.

The Tiger Trap™ system can protect against a vehicle attack without impeding open public spaces.

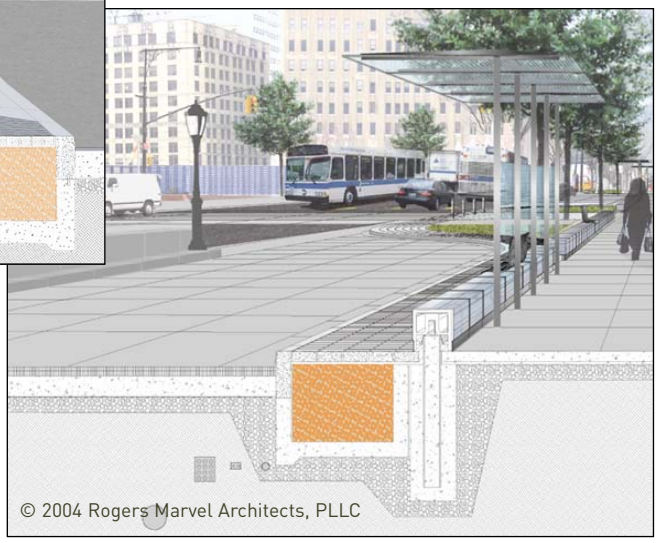


Photo courtesy of the Smithsonian Institution

Effective perimeter security requires a thoughtfully conceived and installed foundation.

Materials

There are four commonly used building materials for perimeter security barriers: steel, cast iron, reinforced concrete, and granite (or other stone). The advantages and disadvantages to each material must be considered when designing site-specific security solutions.

Steel or **cast iron** can be used in almost any design and are usually easier to install than other materials. Steel and cast iron are very strong and will allow for a smaller barrier to stop a vehicle compared to concrete. Steel and cast iron barriers require more maintenance than other materials, such as concrete. For example, routine painting is necessary to prevent rust.

Reinforced concrete barriers take more time and manpower to install, but require little maintenance and are typically less expensive than steel or cast iron. Because concrete structures are commonly found in urban environments, this material is often more compatible with the surrounding context.

Granite or **stone** security elements must be larger than steel or reinforced concrete elements and are often used in enclosed earthen walls (plinth walls) or as benches. Granite is very durable and attractive, complementing the architecture of many buildings. Despite these differences, almost any design can be created with any of these materials.

Foundations

The foundations of perimeter security elements are as important as the above-ground components in stopping a vehicle. Determining the proper foundation for a security barrier is dependent upon strength requirements and site conditions. The barrier foundation must be strong enough to resist a specified vehicle weight at a specific speed.

Perimeter security must often be designed in locations that conflict with subsurface utilities such as electrical, telephone, gas, and water lines. Soil conditions and drainage patterns will also impact the decision of foundation types. Once these conditions are identified, three primary types of footings can be considered.

A **deep continuous foundation** is useful in instances where complicated subsurface utilities are not a concern. All of the elements will be attached to a continuous piece of concrete that is created using steel reinforcement (rebar) to add strength.

Shallow-horizontal foundations are typically used in areas where underground utilities or structures prevent construction of deeper, continuous footings. The structural integrity of a shallow-horizontal foundation is derived from a substantial grid of steel that is close to the surface but extends over a large horizontal plane.

A **pile foundation** involves driving a steel or concrete sleeve deep into the ground for structural support. This type of foundation is not as economical and may only be necessary in certain soil and load requirement situations.

Only certified Professional Engineers should make decisions regarding the choice of foundation.

Thinking Comprehensively: Building Layout and Site Factors

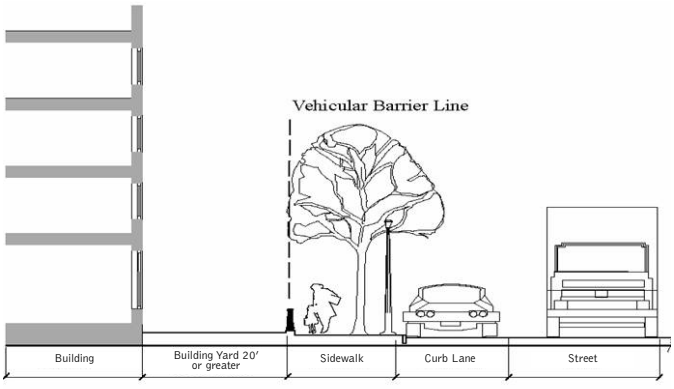
In the design of buildings and perimeter security, consideration must be given to building layout and site planning. Understanding the role of building placement, roadway design, and landscapes is critical to designing effective perimeter security. These aspects play a role in determining the necessary performance level for any security barriers incorporated in a building's perimeter. For example, the placement and configuration of open space and streets can reduce the need for perimeter security elements and lower the required level of performance. Lower required levels of performance can allow for flexibility in design. Designers should take advantage of site characteristics to create successful perimeter security plans.

The layout of buildings on a block and the amount of open space between the building edge and street are important factors in determining permissible penetration levels of vehicles. **Standoff distance** (the distance between a barrier and a protected building) is an important consideration because sufficient distance can preclude the need for large and expensive security measures and allow the use of security elements with decreased performance levels. Smaller standoff distances may require creative design and elements with higher performance standards.

Further guidance on appropriate placement of security elements is provided in the *National Capital Urban Design and Security Plan* and the agency's security objectives and policies.

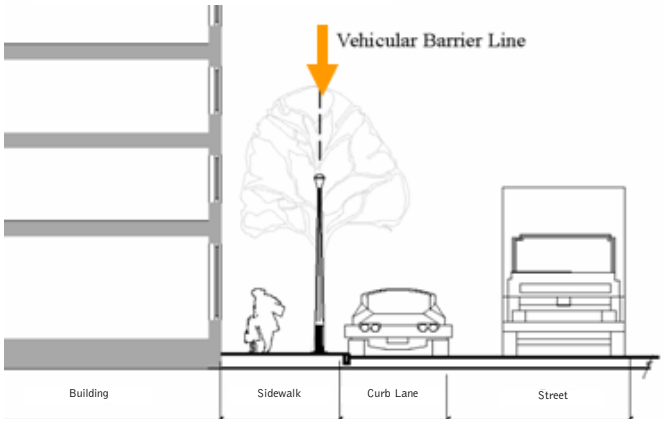
Barrier locations for varying building yards

Building Yard 20' or more



Building Yard Barrier Detail
(Building Yard 20' or greater)

No Building Yard



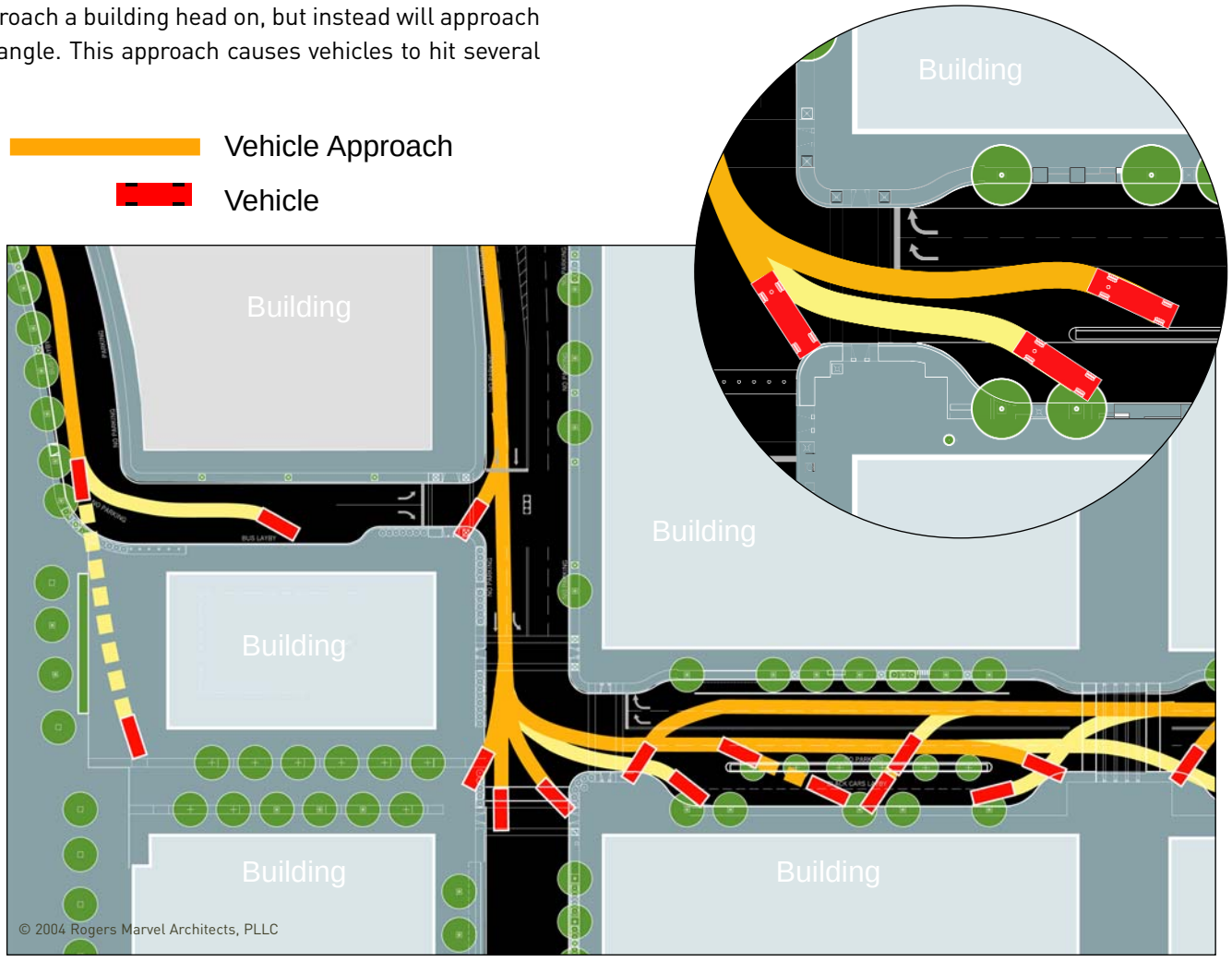
Vehicle Approach Analysis

A careful analysis of the streets surrounding an asset being protected should be done to determine the potential maximum vehicle velocity that the barrier will have to withstand. Straight, perpendicular approaches to buildings allow for the greatest ramming speed for all vehicles. This situation would call for higher performance barriers. Conversely, tight curves in the roadway, narrow streets, and traffic congestion would likely reduce the required performance level for the security element and should therefore be considered during the design phase.

Final design and placement of perimeter security elements is dependent upon a **vector analysis.** This type of analysis seeks to understand the possible angles and speeds of approach around a site for any vehicular threat. Barrier ratings consider a head-on, perpendicular impact to be a worst-case scenario in terms of an attack. More often, vehicles will not be able to approach a building head on, but instead will approach at an angle. This approach causes vehicles to hit several bollards, the curb, and other streetscape obstacles—all of which slow the vehicle down and decrease the amount of energy available to destroy a barrier. Bearing this in mind, designers need not over design security elements; creating monstrous bollards, planters, and other components with performance ratings that will not be necessary. Knowing the context of the site and the level of protection required will save money and allow for aesthetically pleasing streetscapes.

The use of Vehicle Approach Analysis in making perimeter security decisions is policy adopted by the National Capital Planning Commission and reflected in the agency's security objectives and policies.

Vector analysis studies the possible angles and speeds of approach to determine different site vulnerabilities.



The Challenge of Testing Creative Barrier Design

A critical component of designing perimeter security barriers is ensuring that they are capable of stopping vehicles. Testing must be performed to evaluate a barrier's performance and certify its effectiveness.

The lack of a universally accepted testing and certification process for barriers has hindered the development of components that are uniquely designed and appropriate for well-planned streetscapes. Typical testing methods today include a computer simulation, followed by an actual crash test at a controlled facility. The test vehicle's size, weight, and speed are determined by the level of security that a facility requires. Computer simulations can help refine design details and reduce overall costs. However, live crash tests are generally needed to verify the performance of the barrier.

Oftentimes security projects are designed under tight deadlines with limited budgets; therefore few barriers are readily available. This results in availability of a limited number of "off the shelf" items, such as bollards and concrete barriers that may not be appropriate for every location. To prevent such occurrences, design efforts must include time and money for design and testing of perimeter security elements in the early stages of the planning process.

During the early stages of the planning process, adequate time and money must be budgeted to appropriately design and test perimeter security elements.

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Standards for Testing Perimeter Security Elements

When creating new and unique security barriers, it is necessary to ensure that they are capable of stopping a moving vehicle. Testing these barriers is a critical component to designing appropriate perimeter security. A key aspect of testing an element is having a **proper standard** by which to measure its effectiveness. Until recently, the general standard in use was that created by the Department of State (Certification SD-SDT-0201-Specification for Vehicle Crash Test of Perimeter Barriers and Gates). Though this standard was created for use in overseas installations, the standard has been utilized for domestic purposes in the wake of the terrorist attacks using bomb-laden vehicles. However, the standard does not provide for much flexibility in design.

To address this issue, **ASTM International** has developed a new standard **(WK2534 - Standard Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates)** to expand upon the Department of State's crash test standard. The new standard, which is currently under development, will establish performance levels based on a range of vehicles, speed of vehicles, and permissible penetration levels. These standards are an appropriate metric for determining the strength of a barrier.

Standard Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates (work item number WK2534) can be obtained through the ASTM International Website at **www.astm.org**

Overview of the process for testing an anti-ram barrier at an ASTM-certified facility:

1) Select the type of barrier to be designed.

2) Select vehicle type that the barrier should stop; determine potential approach speeds of vehicle; and determine the desired performance characteristics of the barrier (penetration levels, reusability, etc.)

3) Determine specific site conditions (soil conditions, topography, etc.) where the barrier will be located.

4) Run preliminary tests of the barrier through a computer simulation model. Barrier design specifications should be adjusted until the barrier performs properly in the simulation.

5) Field test the barrier to verify results from the computer simulation.

6) Assign the barrier a pass or fail rating.

Review Process for Public Space

When developing a perimeter security design in any jurisdiction, it is critical to include input from agencies that have jurisdiction over the project. The National Capital Planning Commission has specific design review jurisdiction over federal development projects in the nation's capital, and the District Department of Transportation has jurisdiction over the installation of objects in the city's public space.

National Capital Planning Commission

Congress created the National Capital Planning Commission (NCPC) to serve as the central planning agency for the unique concentration of federal activities in the District of Columbia and surrounding cities and counties in Maryland and Virginia. One of NCPC's principal responsibilities is to coordinate development activities of federal and District of Columbia agencies in the region. Section 5 of the National Capital Planning Act of 1952, as amended (40 U.S.C. 71d), requires each federal and District of Columbia agency—prior to the preparation of construction plans or to commitments for the acquisition of land in the region—to consult with NCPC in its preliminary and successive stages of planning.

NCPC reviews development proposals at the conceptual, preliminary, and final stages of design. Any physical improvements that will be in place more than 60 days should be submitted for approval. For further information on NCPC's review process, visit **www.ncpc.gov.**

District Department of Transportation

The District Department of Transportation (DDOT) permits the use or occupancy of the public right-of-way. DDOT must approve a streetscape plan for any project in the downtown area in which 50 percent of the adjoining public space (including sidewalks) is planned for construction. Currently, the Public Space Committee (PSC) reviews permit applications for occupancy of the public rights-of-way, including sidewalk cafes, retaining walls, fences, and security bollards.

For more information on DDOT's current public space process and its proposal to reform the composition and function of the PSC, visit **www.ddot.dc.gov** and select "Types of Permit" and "Public Space Permit Reform Proposal," respectively.