



APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE

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APTA Transit Infrastructure
Security Working Group

Fencing Systems to Control Access to Transit Facilities

Abstract: This *Recommended Practice* provides guidance for the installation of fencing systems to control access to areas under the jurisdiction of a transit agency.

Keywords: access control, analysis, assessment, CPTED, gate, landscaping, lighting, threat and vulnerability fencing systems

Summary: A fencing system is a component of access control systems. It defines boundaries and limits, and channels access and egress, provides visual barriers, supports security and safety, and can deter and delay intrusion and trespassing. Many fencing systems are available to the public transportation industry, ranging from high-security grille type to cost-effective chain link. Fencing systems should be integrated with other security standards and best practices, such as crime prevention through environmental design, lighting, barriers, and so on, to provide protection and enhance other security solutions. This *Recommended Practice* is intended to ensure that security measures are employed in the design, material specification, installation and placement of fencing systems; that security considerations are incorporated during the design and building process; and that all pertinent stakeholders are identified in the process of selection and placement of fencing systems.

Scope and purpose: This document is considered the master fencing systems *Recommended Practice* document for physical fencing systems only, and does not include virtual or other technology-driven fencing systems. Other fencing *Recommended Practices* were developed for specific fencing systems. They include chain link, mesh and woven wire fencing systems, ornamental fencing systems, and gate systems (see References section).

This Recommended Practice represents a common viewpoint of those parties concerned with its provisions, namely, transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a rail transit system's operations. In those cases, the government regulations take precedence over this standard. APTA recognizes that for certain applications, the standards or practices, as implemented by individual rail transit agencies, may be either more or less restrictive than those given in this document.



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The American Public Transportation Association greatly appreciates the contributions of the Transit Security Infrastructure Working Group, who provided the primary effort in the drafting of this *Recommended Practice*.

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1. Stakeholder considerations

To the extent possible, fencing systems should be designed to meet the specific needs of users of transit facilities, including parking, walkways, and internal or underground areas. Installation of fencing systems should serve a meaningful purpose, be conducive to operations and not become a financial or maintenance burden. System design should comply with local and community ordinances but also complement the crime prevention through environmental design (CPTED) principle of natural surveillance in the appropriate environment. Fencing systems can provide the following benefits:

- Give notice of legal boundary of the outermost limits of a facility.
- Assist in controlling and channeling people into or along specific areas and deterring entry elsewhere along the boundary.
- Support surveillance, detection, assessment and other security functions by providing a zone for installing intrusion detection equipment and closed-circuit television (CCTV).
- Create a psychological deterrent.
- Deter casual intruders from penetrating a secured area by presenting an obstacle that requires an overt action to climb over, under or through, and further demonstrates the intent of an intruder to gaining entry.
- Cause a delay in access to a facility, thereby increasing the possibility of detection.
- Reduce the staffing requirements at a site by optimizing the frequency and saturation of the patrol area, which may lead to enhanced detection and apprehension of unauthorized individuals.
- Provide a cost-effective method of protecting facilities.

2. Risk assessment considerations

Transit agencies should evaluate risks and use systemwide and asset-specific risk assessments as a guide in determining effective placement of fencing systems to maximize transit security.

2.1 Systemwide assessment

Transit agencies should refer to their security risk assessments to determine the risks to their systems' assets and the surrounding environment. Transit agencies that do not have existing security risk assessments should develop them using current government guidelines.

2.2 Transit facility risk assessment

To determine specific passenger facility and nonrevenue area risks, refer to the agency asset's criticality ranking and the security and risk management issues for each specific location being considered. Transit agencies should use a risk-based assessment approach to identify safety and security threats to their transit system. The approach may also evaluate system vulnerabilities to those threats and determine the consequences to people, equipment and property. The results should be used to determine appropriate fencing system requirements for the protection of critical infrastructure and the deterrence of crime in transit facilities.

3. Crime prevention through environmental design

Consider applying the CPTED principles of natural surveillance, natural access control, territorial reinforcement and maintenance to the design and planning of a fencing system. A CPTED survey may identify or recommend enhancements that can be employed as crime prevention or other security measures.

4. Site considerations

Many factors can impact fencing system installation, operations and maintenance. However, fencing system material construction, fencing height and installation method are key factors in fence selection. Transit agencies should strive to identify all factors when evaluating existing and designing proposed fencing

systems. Site considerations should include the assessment of hazards as well as threats. They should also include the following:

- Identify high water tables, retaining ponds and site grading plan drainage above and below ground, which may affect the material condition of fencing components or footings, or can affect drainage or result in debris buildup.
- Identify topography and analyze surface and subsurface soil components and other conditions to determine suitability and stability for fencing.
- Identify surface and subsurface utilities and other installations.
- Check local ordinances, covenants or agreements for restrictions or requirements that may affect fencing system type, style, color, height, etc.
- Determine impact to pedestrian/vehicle circulation, users, the community and the transit service.
- Identify frequency, location and targets of vandalism, which may influence the type, style or manufactured components of the fencing design.
- Identify perimeter boundary lines and footprint so as not to encroach on nontransit agency property. Determine the property's minimum footprint to establish a boundary that creates stand-off distance and a clear zone.
- Identify load, wind or other ratings associated with area weather patterns, conditions or other hazardous conditions, such as wind and snow, seismic, wildfire, etc., that may damage or destroy fencing components or structure; weaken its strength or stability; or allow climbing, jumping or stepping over to penetrate the perimeter's boundary. For example, fallen trees on fencing or snow removal staging.
- Complete a CPTED survey of the property to identify natural access and surveillance, territorial reinforcement, crime prevention, as well as homeland security exposures and recommendations. Periodically review and update agency CPTED surveys to address changes in community trends or the surrounding environment.
- Complete a site survey of the property boundary to identify pre-existing conditions, such as adjacent property clear zones, stand-off distance, property encroachment, etc. Complete, review and update the site survey annually to address changes to the site or its surrounding conditions.
- Investigate and research to identify the locations of fencing systems located within close proximity to power lines, catenary wires, and the third rail to determine the proper grounding of power systems.
- Identify possible interference of fencing materials with local communications (radio) networks.

5. Fencing systems

Fencing system material, construction, installation method and fencing design are significant factors to determining fencing system selection. A listing of common industry types of fencing system used in the transit system environment is included in other fencing *Recommended Practices*. These *Recommended Practices* provide types and descriptions of other fencing systems, as well as their potential use in the transit environment. The types described include split rail, ornamental, chain link and metal mesh.

Fencing systems materials are typically metal, aluminum or wood construction. Each of the materials has specific maintenance issues and concerns that can impact the use and life expectancy of the system. Additionally, other materials, such as vinyl, plastics, composites and combined wood-metal-plastics-composite products are being introduced to the fencing system industry. Some of these materials have demonstrated use in reducing maintenance, upkeep and repair, as well as increased life cycle, and should be considered in the final fencing system selection.

Some fencing systems are designed and installed for temporary use, while others are installed for short- to long-term or even permanent use. A combination of the types of installation that may best suit a facility or an area's specific security requirements should be carefully evaluated as part of the security risk assessment and

design processes. Because installation is key to fencing system design and selection, there are as many installation methods as there are varieties and types of fencing system. Therefore, the manufacturer's recommended installation methods should be followed.

Materials left or piled near the fence, such as debris, vehicles or snow, may create vulnerabilities and should be discouraged. Intruders may use these materials to help them climb over a fencing system to enter or leave the property.

Each type of fencing system has strengths and weaknesses, and the factors unique to the site may create other impacts or enhancements. Regardless, the factors for each design should be carefully evaluated against each proposed fencing system prior to a final installation decision. Furthermore, the basis for installing a fencing system should be well defined and included in any design plans implementing such physical security measures.

6. Application of fencing systems

The environment in which the fencing will be installed will influence the height, application and type of fencing system selected. For example, some fencing systems may be appropriate for a sidewalk or walkway, while more robust or reinforced fencing systems may be appropriate around critical infrastructure, the perimeter etc. The type of fencing system should be suitable to its application and environment. Local ordinances and code requirements should be reviewed during the planning stages of design to determine if any fencing system requirements or restrictions apply. Fencing system designs should also be reviewed by the agency's security management to ensure current security industry best practices are being considered and applied. Site applications, heights, material gauges and diameters of mesh/opening recommendations for fencing systems in the transit environment are listed in the appropriate fencing system *Recommended Practice*.

7. Clear zones

Clear zones provide an unobstructed view of the fencing system to make it more difficult for potential intruders to be concealed from observation. They also provide natural surveillance (a CPTED principle) for both sides of the fencing system. Where practical, transit agencies should identify and designate clear zones on the exterior and interior sides of their property's fencing system. Clear zones should be free of any objects or features that offer concealment or that could provide unauthorized access to the property, such as overhanging tree limbs, utility poles, posts, etc. Vegetation in clear zones should be 6 inches or less in height to limit cover and concealment of potential intruders. It should be trimmed regularly to prevent overgrowth and cover of the clear zone area. If a clear zone is not practical, then other compensatory measures should be implemented to control access, such as increased fencing system height and controlled lighting, CCTV and detection systems, or security patrols.

8. Stand-off distance

The most effective tool to keep threats from assets is stand-off distance. In general, the more stand-off distances provided, the more the risk is reduced. Stand-off differs from clear zone distance in that there is no ideal stand-off distance; it is determined by threat, type of construction and desired level of protection. Stand-off distances can be incorporated into landscape and streetscape by benches, bollards, barriers or other types of barricade devices. Where practical, the maximum distances for stand-off should be designated and access-controlled.

9. Fencing system protection

Vehicle gates, fencing systems and their components in the proximity of moving vehicle traffic may be prone to damage from vehicles bumping, hitting or otherwise being driven into or through them. However, damage

to gates and fencing systems may be further reduced by considering the environment of the location in the design process. Stand-off distance, wider gate opening, and the installation of bollards or other heavy objects placed to withstand damaging impact are examples that may be considered to protect both gates and fencing systems. A project's design review before final approval and implementation is the most favorable time to identify and rectify any issues that could result in gate and fencing system damage.

10. Grounding

Metal fences can be electrified due to proximity to energy sources. Where applicable, metal objects should be grounded in accordance with local codes and agency engineering guidelines.

11. Fencing systems incorporating anti-vehicle barricade

To enhance anti-vehicle physical security resistance, some fencing systems integrate anti-vehicle barriers into systems designed to control pedestrian access. The anti-vehicle barrier designs may be discreetly incorporated into the fencing system to present an aesthetically appealing look while affording a site with formidable anti-vehicle protection. A site security assessment should be completed to identify any requirement for this type of fencing system/barrier design (see the forthcoming *Recommended Practice* for barricades).

12. Signs

Signage should meet the local community's sign ordinance and be placed at appropriate distances. Signs depicting appropriate international symbols should be used in areas representative of diverse languages, at appropriate crossing locations, and meet Americans with Disabilities Act requirements. Signs should be installed in clear view to avoid concealment and posted or attached to the fencing system materials at uniform intervals conforming to local ordinances to deter accidental or inadvertent trespass by an intruder. Signage may provide directions to bus stops or transit stations; provide warnings, such as "No Trespassing," "Private Property," "Restricted Area," "Authorized Personnel Only" or "No Clearance"; or provide other general information, such as operating hours or vending service machine location or guidance.

13. Gates

Gates are manufactured in many variations (swing, slide, horizontal, vertical, etc.) to accommodate identified site requirements, but they are the only moveable part of a fencing system. The purpose of a gate is to channel pedestrian and/or vehicle circulation to and from an area. For that reason, gates can increase or decrease the security requirements at a site and therefore should be closed and locked when not in use. Measures to prevent hinges from being removed (e.g., peen bolts or loop and crimp wire rope around gate and fencing post) should be incorporated in all gate installations. A site vehicular and pedestrian circulation study, coupled with a site security risk assessment, should be completed to determine the number and locations of gates necessary for operations. (See the *Recommended Practice* for gate systems for additional details.)

14. Inspection and maintenance

Fencing systems should be regularly inspected for integrity, functionality and signs of damage. Visual and hands-on inspections can provide the most complete assessment of a fencing system's overall condition. Maintenance should be performed according to the manufactured recommended schedule. Repairs, when necessary, should be completed promptly.

15. Common fencing system elements

Various materials, components and hardware make up a fencing system. Most fencing systems contain some type of common element(s) and are designed under guiding industry practices. However, local ordinances should be checked and verified to ensure compliance with local or other agency requirements and practices. The most commonly designed fencing system elements and industry practices are listed below:

- **Posts.** Fencing system posts should be as tall in height as the material they support; be of sufficient strength to hold the fencing materials in place; and be firmly set in the ground to prevent shifting by wind, erosion or other environmental conditions.
- **Material.** Fencing system materials (wood panels, plastic weave, metal diamond mesh, aluminum pales or pickets, etc.) should be securely fastened to posts and supporting hardware (bracing bars, rods, wire, etc.) to prevent sag, sway or removal. The smaller the mesh opening, the more difficult it would be to cut or use as a foothold or handhold. The closer the panels are fastened next to one another, the less opportunity there is for a person to fit between them to gain access through the opening. Horizontal and vertical fencing system rails should be secured in place to prevent removal.
- **Height.** Fencing system materials should be at least the height of the posts supporting them, where applicable. Materials installed in a security environment should always be higher than supporting posts.
- **Hardware.** All hardware and components (nails, screws, nuts, bolts, hinges, bracing, rods, wire, etc.) should be installed on the inside of the fencing system when feasible.
- **Other.** Elements for ornamental and chain-link fencing systems are listed in other specified *Recommended Practices*.

16. Security best practices for general fencing systems

Transit system security awareness and the implementation of best practices can affect a transit agency's overall security posture. Several examples of transit security fencing system best practices are listed below:

- **Top guard.** May be considered depending on the results of the transit agency's security risk assessment.
- **Enablers.** Boxes or other materials stacked against or in close proximity to perimeter barriers enable intruders to climb over a fencing system. Remove vegetation, objects, debris and material that could be used to breach a fencing system or hide intruders.
- **Perimeter openings.** Address openings in the perimeter that allow uncontrolled access (culverts, ditches, etc.) These openings should be secured to a degree equivalent with the perimeter boundary.
- **Water boundary/perimeter.** If a body of water forms any part of the perimeter, then additional security measures to restrict access should be provided.
- **Bury the mesh material.** Burying the mesh material approximately 12 inches (30.5 centimeters) deep can deter penetration under the chain link, mesh and woven fencing system's perimeter. As an alternative, pour a concrete "apron" of at least 6 inches (15.2 centimeters) at the bottom of the mesh fabric to fill any gaps between the ground and the bottom of the mesh.
- **Contrast.** Designing color contrast into fencing system components can increase or decrease the natural surveillance of installed fencing system fabric. For instance, dark foreground colors against light background colors enhance the ability to see the details of activity along a perimeter fence line, whereas light foreground colors against dark backgrounds can have the same effect of enhancing view. However, the contrast afforded by dark- or light-colored fencing system components can be limited if they are not adequately analyzed against color patterns or treatments, as well as the changing seasons of the area. Therefore, an analysis of the tones, patterns and canopy colors common in the area should be completed and the results understood before implementing and committing to a specific color/design/pattern.
- **Prevent hardware component removal.** Peen or spot-weld all nuts to bolts. This action reduces the potential removal of nuts and bolts.
- **Add secondary fencing around critical infrastructures.** Install a second fencing system to increase security around identified critical infrastructures, as identified through a security risk assessment.
- **Culverts, troughs, drainage ditches.** Openings greater than 96 square inches (244 square centimeters) should be protected by chain link, mesh or woven fencing systems. The protection may

consist of iron grille mesh or other barrier device(s) designed to prevent unauthorized access but should not impede the flow of drainage. Hinged grille mesh that may be opened should incorporate high-security hasps, shackle and padlock, etc.

- **Fencing system checklists.** Appendixes A and B provide additional guidance and information for planning and designing fencing systems but are not all-inclusive. The Fencing System Checklist should be consulted when considering installation of any fence. The Gate System Checklist may be consulted as needed.

Appendix A: Fencing System Checklist

The checklist below can be used to help identify selection criteria and determine design, location and installation of a fencing system for access control.

Fencing System Checklist	
Conducted by:	Date:
1. Has a transit facility risk assessment of the property/facility been completed?	
<input type="checkbox"/> Yes, it was completed by _____. <input type="checkbox"/> No, but it will be completed by _____.	
2. If so, are there action pending on the assessment findings? What are they?	
3. Identify the primary purpose for a new or refurbished fencing system.	
4. Does a local jurisdiction direct any fencing system restrictions or prohibitions (height, type, color, style, etc.)?	
5. Is there an organizational, community or local ordinance requirement for the fence to be aesthetically pleasing?	
6. Does the fencing system meet the transit agency's established security design requirements?	
7. Have the appropriate safety factors (OSHA, NFPA, ADA, state, local ordinance, code, etc.) considered in preparation for the fencing system?	
8. Will the fence line have any breaks?	
9. Are there any obstructions in the clear zone? Does the fence obstruct the right of way?	
10. List the stand-off distance available on both sides of the fencing system.	
11. Does the fencing system require grounding?	
12. Will a review be performed to ensure that best practices, value and operational functionality are incorporated into the fencing system's final selection, design and installation?	

13. Are the selected fencing system material and components designed to resist corrosion or other environmental effects?
14. Will the selected fencing system design function accordingly under extreme environmental conditions?
15. Will the designed fencing system contrast or blend with the region/area topography or geography of the site?
16. Will the security design include peening, spot welding or damaging exposed threads, bolts and nuts to prevent removal of hardware?
17. Are culverts, drains and pipes that enter the property protected against unauthorized access?
18. Who will regularly inspect the fencing system for damage, maintenance or operations? When was the last inspection completed?
19. Is the fencing system subject to vehicle damage, either intentional or unintentional?
20. How will fencing system damage or inoperable components be reported and repaired?
21. Will regularly scheduled maintenance be performed in-house or by contractor?
22. Has a property site survey been completed to identify natural and human-made pre-existing conditions, such as adjacent property clear zones, stand-off distance, property encroachment, etc.?
Comments:

Appendix B: Gate System Checklist

Gate System Checklist	
Conducted by:	Date:
1. Identify the primary purpose for a new or refurbished gate system. Explain.	
2. How many vehicle and/or pedestrian gates are on the property?	
3. How many vehicle and/or pedestrian gates are required?	
4. How many vehicle and/or pedestrian gates on the property are actively in use? How many are inactive?	
5. Is there an organizational, community or local ordinance requirement for the fence to be aesthetically pleasing?	
6. Does the gate system meet the transit agency's established security requirements?	
7. Are the appropriate safety factors (OSHA, NFPA, ADA, state, local ordinance, code, etc.) considered in preparation for the fencing system?	
8. Does the gate system have to be appropriately grounded?	
9. Will the gate system require manual, electrical or hydraulic power to operate?	
10. If electrical power, where will the primary power source be drawn from?	
11. Will there be a backup power source to draw from in the case of loss of primary power?	

12. Can the operating system be impaired by severe weather conditions, including snow, ice, excessive water, winds, earthquake, or animals? Explain all.

13. Was a traffic study completed to analyze whether an adequate turning radius and gate wing were provided for long and wide vehicles passing through vehicle gates (to ensure that industrial vehicles can turn and travel through a vehicle gate without damaging the fencing system)?

14. Does the gate system have an operational lock device? Is it used?

15. Does the gate system have an operational automatic closing device?

16. Does the gate system have hinge protection in the forms of cabling, peening, double not or spot welded bolts to prevent gate removal from the hinge side?

17. Will the gate system be guarded by a guard force when opened?

18. Where will the guardhouse be positioned to take advantage of view and entry control?

Comments:

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Definitions

asset: Any real or personal property, tangible or intangible, that a company or individual owns that can be assigned a monetary value.

barbed wire: Twisted wires armed with barbs or sharp points. Also called barbwire.

clear zone: An area surrounding the perimeter of a facility that is free of shrubs and trees and features well-maintained landscaping that does not provide hidings places for an adversary.

crime prevention through environmental design: The broad study and design of environments to encourage functionality and decreased antisocial behavior.

critical infrastructure: The fixed physical assets critical to the operations of a transit agency.

chain link, mesh and woven fencing systems: A physical security entry control measure. They are installed to control, channel or restrict the entry or exit of personnel to a location or an area. Chain link, mesh and woven fencing systems can be temporary or permanent, active or passive.

diamond pattern: The opening formed in chain-link mesh wire fencing fabric during its manufacture.

fencing system: A physical security entry control measure. It is installed to control, channel or restrict entry or exit of personnel and equipment to a location or an area. Fencing systems can be temporary or permanent, active or passive.

gate system: The only moveable components of a fencing system. The gate components control, permit, channel or restrict entry and access to an area. Components may include the frame, top guard, fabric, hinges, latches, operators, locking devices, etc.

gauge: The thickness of the steel wire or metal material used in the manufacture of metal fence mesh.

Knox-Box: Known officially as the KNOX-BOX Rapid Entry System, is a small, wall-mounted safe that holds building keys for firefighters to retrieve in emergencies. Local fire companies can hold master keys to all such boxes in their response areas so that they can quickly enter a building without having to force entry or find individual keys held in deposit at the station. Knox-Boxes designed with technology interfaces are linked via radio to the dispatch station, where the dispatcher can release the keys with dual-tone multi-frequency (DTMF) tones.

mesh: The open pattern on a panel of fencing fabric.

natural access control: The physical guidance of people and equipment coming and going from a space by the placement of entrances, exits, fencing systems, landscaping and lighting. See *natural surveillance* and *territorial reinforcement*.

natural surveillance: The placement of physical features, activities and people in a way that maximizes visibility. See also *natural access control* and *territorial reinforcement*.

nonrevenue transit facility: A facility in which public access is restricted. Nonrevenue facilities include, but are not limited to, operations control centers, maintenance facilities, bus vehicle storage yards, rail vehicle storage yards, traction power substations, communication rooms, train control rooms, emergency fan plants, elevator rooms, passenger station ancillary rooms, and other similar facilities.

ornamental fencing system: An aesthetically designed fencing system used as a physical security entry control measure. It is installed to control, channel or restrict entry or exit of personnel and or equipment to a location or an area. Ornamental fencing systems are usually permanent and are either active or passive. Ornamental fencing is manufactured with tubular steel, aluminum or a combination of alloys. These materials, plus the arrangement of pales or pickets, allow this type of fencing to be used in high-security applications.

outrigger: A single metal brace installed at an angle designed to hold barbed or other type wires or coils in place at the top of a fencing system and or gates. Double outriggers (forming a V) may be installed at the top of a fencing system.

panel: Fencing fabric of various opened or closed patterns and or designs, manufactured in sections to be attached to posts.

pattern: The opening formed in mesh wire fencing fabric during its manufacture.

peen: To strike a piece of metal with a hammer, denting the surface, or mashing the threads of a bolt after installing a nut, to prevent the nut from being removed.

rail: Horizontal fencing system component connected or attached to anchored posts at each end of rail. Rails can be manufactured of metal, plastic, composite or wooden materials.

razor tape: a mesh of metal strips with sharp edges whose purpose is to prevent passage by humans.

risk assessment: A formal methodical process used to evaluate risks to a transit system. The security portion of the risk assessment identifies security threats (both terrorism and crime) to the transit system; evaluates system vulnerabilities to those threats; and determines the consequences to people, equipment and property.

revenue transit facility: A publicly accessible transit facility, or the publicly accessible portion of a mixed revenue/nonrevenue facility. Includes passenger stations and terminals, etc.

spot welding: A means of preventing the physical removal or disassembly of chain link, mesh and woven fencing system hardware and components. For instance, spot welding a nut to its bolt prevents removal.

selvage: The manufacturers' finish to the top and the bottom of a fabric.

stand-off: The distance maintained between an asset or portion thereof and the potential location for an explosive detonation or other threat.

station: A type of public transportation passenger facility designated for the purpose of boarding and deboarding passengers. Station features and amenities may include information/waiting areas, boarding and alighting platforms, ticket/fare card sales, turnstiles or other fare collection equipment, restrooms, concourses, mezzanines, vendor shops and other related facilities.

transit agency: The organization that operates transit service and other related transportation services.

territorial reinforcement: The use of physical attributes that express ownership, such as fences, signage, landscaping, lighting, pavement designs, etc. See *natural access control* and *natural surveillance*.

top guard: Additional protection of fences that are placed at the top of the fence to prevent jumping or climbing. Examples of top guards can include barbed wire, concertina wire and razor tape.

Abbreviations and acronyms

ADA	Americans with Disabilities Act
ASIS	American Society for Industrial Security
CCTV	closed-circuit television
CPTED	crime prevention through environmental design
DTMF	dual-tone multi-frequency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
NCHRP	National Cooperative Highway Research Program
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration