Unit IX (C)

COURSE TITLE Building Design for Homeland Security for Continuity of Operations (COOP) Train-the-Trainer **TIME** 150 minutes

UNIT TITLE Site and Layout Design Guidance

OBJECTIVES

1. Identify site planning concerns that can create, reduce, or eliminate vulnerabilities and understand the concept of "Layers of Defense."
2. Recognize protective issues for suburban site planning.
3. Compare the pros and cons of barrier mitigation measures that increase stand-off or promote the need for hardening of buildings at risks.
4. Understand the need for keeping up with the growing demand for security design.
5. Understand the benefits that can be derived from appropriate security design.
6. Understand the benefits of adopting a creative process to face current design challenges.
7. Understand the benefits of including aesthetic elements compatible with security and architecture characteristics of building and surrounding environment.
8. Apply these concepts to an existing site or building and identify mitigation measures needed to reduce vulnerabilities.

SCOPE

The following topics will be covered in this unit:

1. Land use considerations both outside and inside the property line.
2. Site planning issues to include site design, layout and form, vehicular and pedestrian circulation, and landscape and urban design.
3. Creating stand-off distance using perimeter controls, non-exclusive zones, and exclusive zones along with the design concepts and technology to consider.
4. Design considerations and mitigation measures for site security.

REFERENCES

1. FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*, Chapter 2; Checklist at end of Chapter 1
2. FEMA 430, *Site and Urban Design for Security*
3. FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings*, pages 5-1 to 5-16
4. Case Study – Appendix C: COOP, Cooperville Information / Business Center
5. Student Manual, Unit IX (C) (info only – not listed in SM)
6. Unit IX (C) visuals (info only – not listed in SM)

REQUIREMENTS

1. FEMA 426, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings* (one per student)
2. FEMA 452, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings* (one per student)
3. Instructor Guide, Unit IX (C)
4. Student Manual, COOP Case Study (C) (one per student)
5. Overhead projector or computer display unit
6. Unit IX (C) visuals
7. Risk Matrix poster and box of dry-erase markers (one per team)
8. Chart paper, easel, and markers (one per team)

UNIT IX (C) OUTLINE

PREPARING TO TEACH THIS UNIT

- **Tailoring Content to the Local Area:** This is a generic instruction unit, but it has great capability for linking to the Local Area. Local Area discussion may be generated as students have specific situations for which they would like to determine vulnerabilities or vulnerability rating prompted by points brought up in the presentation.

- **Optional Activity:** There is no optional activity for this unit.

- **Activity:** The students will continue familiarizing themselves with the Case Study materials. The Case Study is a risk assessment and analysis of mitigation options and strategies for an alternate facility to be assessed for potential Continuity of Operations (COOP). This alternate facility is a typical commercial office building located in a mixed urban-suburban environment business park. The assessment uses the DoD Antiterrorism Standards and the GSA Interagency Security Criteria to determine Levels of Protection and identify specific vulnerabilities. Mitigation options and strategies will use the concepts provided in **FEMA 426** and other reference materials.

- Refer students to their Student Manual for worksheets and activities.

- Direct students to the appropriate page (Unit #) in the Student Manual.

- Instruct the students to read the activity instructions found in the Student Manual.

- "Walk through" the pages of the activity with the students, describing the steps followed to obtain the answers in the completed examples, and what is expected of the groups for this activity.

- For this activity, the assessment of the site and layout of the building in greater depth may result in the group adjusting the Risk Matrix scores for vulnerability rating, with resultant changes to risk rating. Transfer these changes to the Risk Matrix poster.

- Tell students how long they have to work on the requirements.

- While students are working, all instructors should closely observe the groups' process and progress. If any groups are struggling, immediately assist them by clarifying the assignment and providing as much help as is necessary for the groups to complete the requirement in the allotted time. Also, monitor each group for full participation of all members. For example, ask any student who is not fully engaged a question that requires his/her viewpoint to be presented to the group.

- At the end of the working period, reconvene the class.

- After the students have completed the assignment, "walk through" the activity with the students during the plenary session. Call on different teams to provide the answer(s) for each checklist section of questions, in summary fashion or select representative questions in each section as the starting points of discussion. Then simply ask if anyone disagrees. If the answer is correct and no one disagrees, state that the answer is correct and move on to the next requirement. If there is disagreement, allow some discussion of rationale, provide the "school solution," and move on.

- If time is short, simply provide the "school solution" and ask for questions. Do not end the activity without ensuring that students know if their answers are correct or at least on the right track. Note, there are no right or wrong answers, but all answers must be justified with rationale.

- Ask for and answer questions.

Editor Note: Two methods have been used in Instructor Guides to ensure the slide designation and slide thumbnail in the left column aligns with the Content/Activity in the right column.

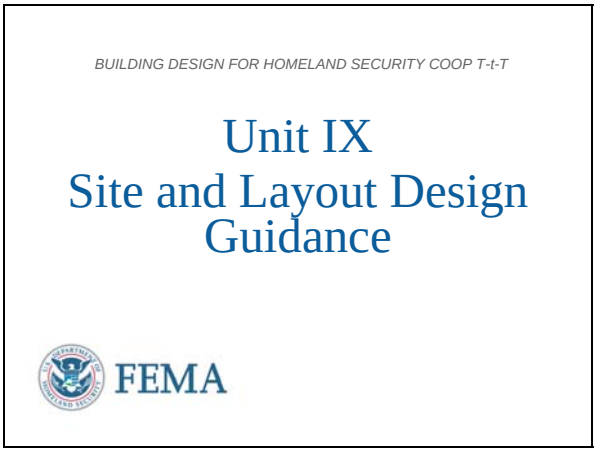
(1) Highlight row by placing cursor in left column until arrow shifts to right, Tab <Insert>, <Break>, <select Page Break>, <OK>

(2) Highlight row as in (1), right click on highlighted row for menu, <Table Properties>, Tab <Row>, remove check in box <Allow row to break across pages>

(3) Alternate for (2), highlight row, click on <Table> at top of screen, <Table Properties> and continue like (2)

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

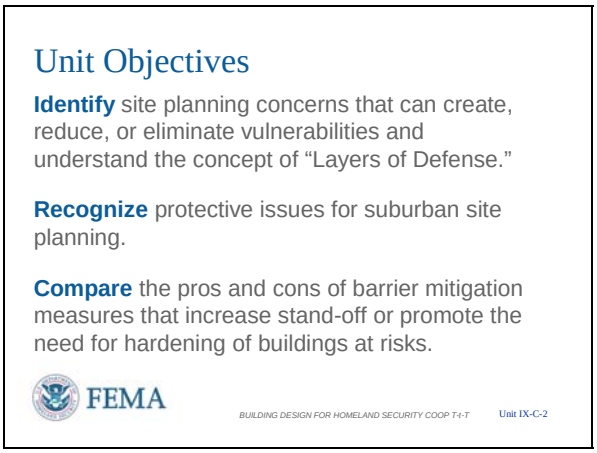
Unit IX-C-1



Introduction and Unit Overview

This is Unit IX, Site and Layout Design Guidance. This lecture will examine site level considerations and concepts for integrating land use planning, landscape, architecture, site planning, and other strategies to mitigate the design basis threats. The students will gain an understanding of the myriad options available to enhance site design taking into account many environmental challenges.

Unit IX-C-2



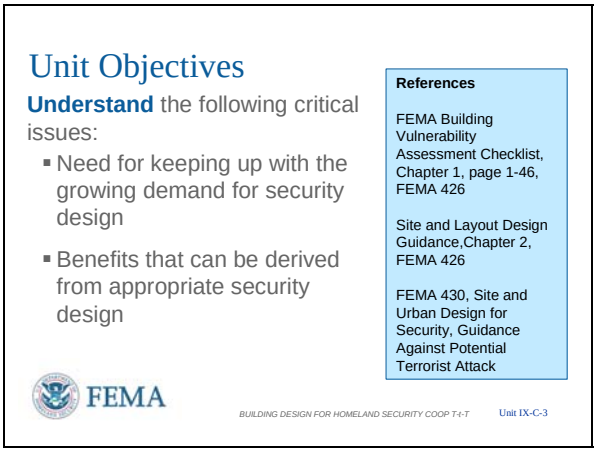
Unit Objectives

At the end of this unit, the students should be able to:

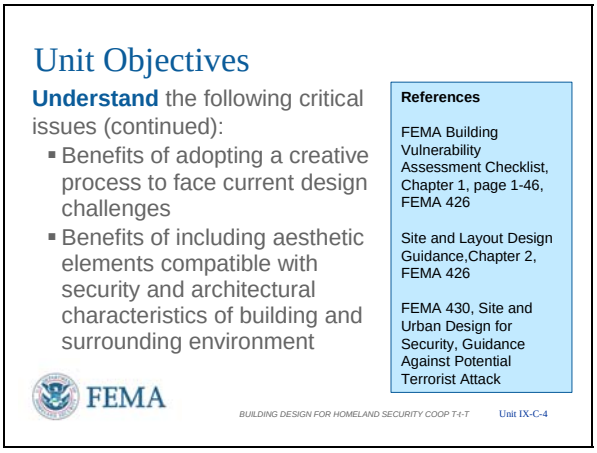
1. Identify site planning concerns that can create, reduce, or eliminate vulnerabilities and understand the concept of "Layers of Defense."
2. Recognize protective issues for suburban site planning so as to aid in selecting appropriate mitigation measures.
3. Compare the pros and cons of barrier mitigation measures that increase stand-off and the need for hardening buildings at risk.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-3



Unit IX-C-4



Unit Objectives (cont.)

5. Understand the benefits in keeping up with the growing demand for security design issues. The technology and manufacturing continues to improve.
6. Understand the benefits that can be derived from appropriate security design. Meeting security design can satisfy other requirements at the same time.

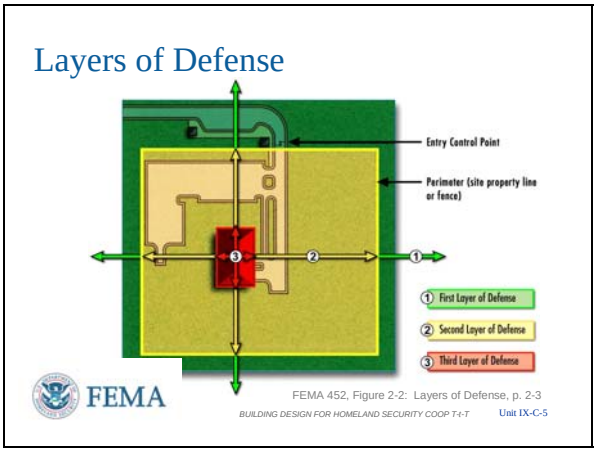
FEMA 426 and FEMA 430 contain architectural and site planning considerations for new design or renovation of existing.

Unit Objectives (cont.)

7. Understand that there are benefits to adopting a creative process to face current design challenges. While many criteria are prescriptive, there are many techniques to meet the spirit, intent, purpose, and performance sought.
8. Understand that design can include aesthetic elements that are compatible with security and architectural characteristics of the building and surrounding environment. Blending security so that it does not look like security and buildings feel open and friendly should be a goal.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-5



From FEMA 452

The layers of defense is a traditional approach in security engineering and use concentric circles extending out from an area or site to the building or asset that requires protection. They can be seen as demarcation points for different security strategies. Identifying the layers of defense early in the assessment process will help you to understand better the assets that require protection and determine your mitigation options. Figure 2-2 shows the layers of defense described below.

First Layer of Defense. This involves understanding the characteristics of the surrounding area, including construction type, occupancies, and the nature and intensity of adjacent activities. It is specifically concerned with buildings, installations, and infrastructure outside the site perimeter. For urban areas, it also includes the curb lane and surrounding streets. **The building owner has little or no control outside of working with the city or municipality. The first layer of defense should be designed to prevent large bombs or weapons into the site and control access**

Layers of Defense

There should always be multiple layers of defense in order to deter and detect potential threat elements that attempt to access critical assets to their benefit and everyone else's detriment. There may be an additional layer applied around a building when a site is large or one or more additional layers inside a building when a building has functions at various levels of security. The intent is to deter first, then detect sufficiently quickly to have a response force engage the potential threat elements prior to reaching the next layer.

The first layer is the demarcation between control and no control. Outside the first layer the local, regional, and national police and intelligence forces work to track, detain, and arrest the potential threat elements before they can initiate an incident. This should be a controlled perimeter whose intent is to keep large threats outside by deterrence or detect them at this point and prevent entry. If the weapon activates at this layer the effectiveness is reduced if sufficient stand-off exists.

The second layer keeps any smaller weapons that may slip past the first layer from getting close enough to the critical asset to cause damage. This layer should mitigate the effectiveness of tactics, reduce the impact due to insider action, and controls the stand-off from the building for the smaller weapons that may get through.

The first and second layers are primarily the venue for site and layout design, the basis for this unit.

The third layer (usually 3 layers are the minimum found) is the building envelope which also deters and detects, but if an incident occurs this layer is the only one that provides

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of personnel. **Second Layer of Defense.** This refers to the space that exists between the site perimeter and the assets requiring protection. It involves the placement of buildings and forms in a particular site and understanding which natural or physical resources can provide protection. It entails the design of access points, parking, roadways, pedestrian walkways, natural barriers, security lighting, and signage. For urban areas, it refers specifically to the building yard. **The building owner has control of this layer. The second layer controls stand-off from the building which provides protection from weapons that may slip through the first layer of defense.** **Third Layer of Defense.** This deals with the protection of the asset itself. It proposes to harden the structures and systems, incorporate effective HVAC systems and surveillance equipment, and wisely design and locate utilities and mechanical systems. Note that, of all blast mitigation measures, distance is the most effective measure because other measures vary in effectiveness and can be more costly. However, often it is not possible to provide adequate stand-off distance. For example, sidewalks in many urban areas may be less than 10 meters (33 feet), while appropriate stand-off may require a minimum of 25 meters (82 feet). **The building owner has control of this layer and its main mitigation measures are hardening against blast and security sensors/CCTV as final access control.**	any level of protection during the tactic and weapon release. The third layer is the venue for building design which will be found in the next instruction unit. It is important to remember that the nature of any threat is always changing. Consideration should be given to accommodating enhanced protection measures in response to future threats that may emerge. Asset protection must be balanced with other design objectives, such as the efficient use of land and resources, and must also take into account existing physical, programmatic, and fiscal constraints.

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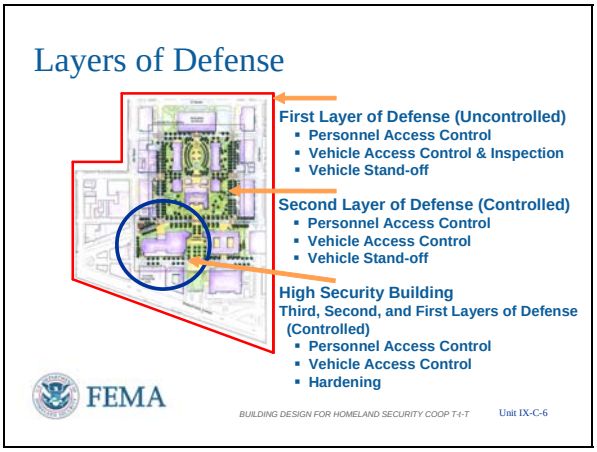
Unit IX-C-6



The layers of defense are not predetermined and they may vary from site to site and from building to building. If a particular building requiring protection is part of a campus or located in a rural, semi-rural, or urban area, a similar analysis may be applicable for all cases when determining the importance of the asset. However, the security elements necessary to protect the building can be entirely different, depending on its location. The approach suggests establishing different demarcation points in order to identify sound security strategies. The layers of defense concept proposes that each designer study a particular site and determine critical assets that need to be protected and how protection should take place.

Note: Layers of Defense will be during this and the next two instruction units to illustrate the elements:

- Deter
- Detect
- Deny
- Devalue

Layers of Defense

The layers of defense convey the idea of using concentric circles extending out from an area or site to the building that requires protection. They are used as demarcation points for different security strategies. The objective of layers of defense is to create succeeding more difficult layers to security to penetrate, provide additional warning and response time, and allow building occupants to more into defensive positions or designated Safe Haven protection.

The layers of defense defines sites and projects as follows *(While the previous slide is a generic explanation, this slide shows the campus or suburban situation where there are more options to the layers of defense)*:

- The first layer addresses the characteristics of the surrounding area and the public realm. It starts at the site perimeter and outward. The building owner has very limited or no control to implement mitigation measures.
- Although a controlled access zone is one of the best methods of ensuring stand-off, issues as the size of site, site limitations, building siting within the parcel, and property line restrictions do not always allow this zone to be created.
- The second layer is concerned with the space and physical barriers at the perimeter of the site to keep explosives at a distance to protect buildings. It comprises the space between the site perimeter and building. The building owner has the authority and control to implement mitigation measures.
- The third deals with the protection integral to the building itself. The building owner has certain level of control to implement mitigation measures. Incorporating the protection in initial design, whether blast hardening or security, is the least expensive approach. Retrofitting after the building has

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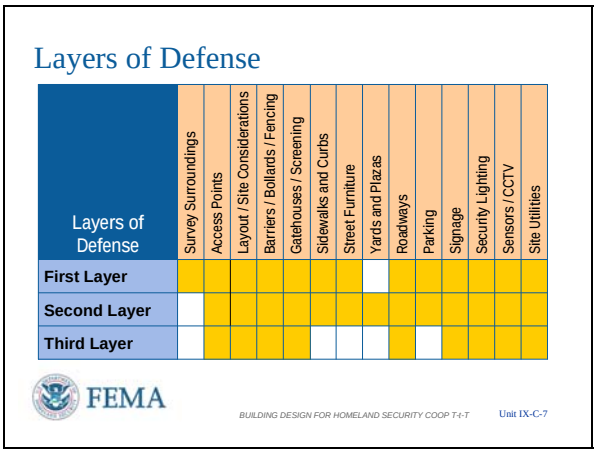
Instructors may want to relate to a castle – First layer of defense is clearing all trees and vegetation out to the effective range of arrows and crossbows. Second layer of defense is moat and initial castle wall. Third layer of defense is the castle keep where the last defensive position exists with its additional walls.

Unit IX-C-7



been constructed can cost up to 30% of the original construction, if the retrofitting can be done.

Layers of Defense

There are many mitigation techniques available that can be used at one or more layers of defense. This instruction unit concentrates on site and layout design, thus it looks primarily at the first and second layers of defense and emphasizes the predominant layer of defense considered.

Here are general mitigation considerations for the suburban environment and this presentation will follow the flow of these measures from left to right – starting with Survey Surroundings on the left and ending with Site Utilities on the right.

The flow also follows the general assessment approach of looking from outside to inside and going from general information to specific information.

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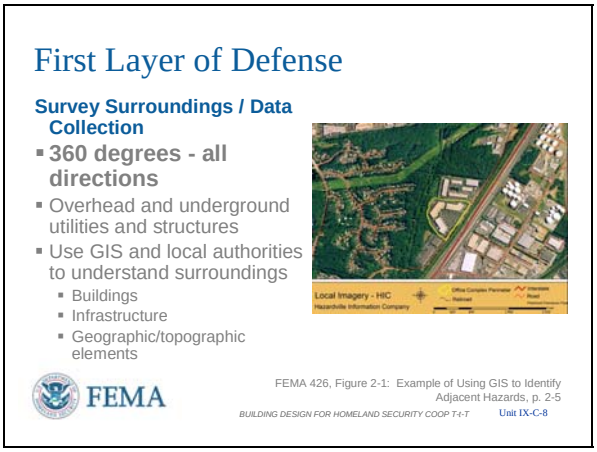
Unit IX-C-8



NOTE to instructor: Emphasize that a **360 degree survey of surroundings** must be done as you cannot ignore what is overhead or underground. Also, the FEMA 452 database has questions specifically targeting these concerns under Site and Sturctural. (These questions are **not yet in** FEMA 426 or FEMA 452.)

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Survey Surroundings – Data Collection

In a suburban environment, this action normally follows the points on a compass -- in the horizontal plane.

However, understanding the surroundings includes any structures above and under the building and site of interest as to their impact on design or assessment. GIS applications are excellent resources that enable designers and building owners to analyze various demographic, hazardous areas, transportation networks, access control points, etc., in order to identify potential threats, hazards, and vulnerabilities. These applications may depict a truer picture of the surrounding situation, allowing decision-makers to take proactive measures to mitigate potential vulnerabilities.

Geographic and topographic concerns include terrain that limits access of vehicles – natural barriers, like water, slope, vegetation, etc.

Access Points

Entry control and vehicular access should:

- Prevent unauthorized access
- Avoid traffic queuing (queues become potential targets)
- Have commercial vehicle gates if possible – keep larger vehicles further away and barriers increased in capability to handle. Have an Alternate Plan B if a suspected vehicle closes down one or the other vehicle gates
- Provide traffic calming
- Avoid high speed approaches
- Have equal security capacity for exit

Traffic calming strategies seek to use design measures to cue drivers as to the acceptable speed for an area. These include raised

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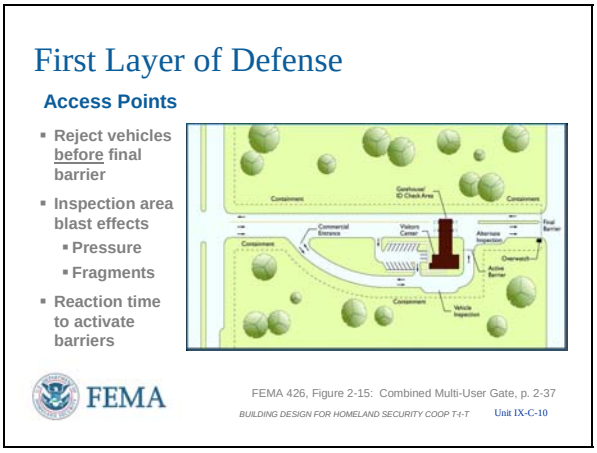
crosswalks, speed humps and speed tables, pavement treatments, build outs, and traffic circles. Additionally, by controlling the angle of approach, requiring turns or providing curves, vehicles must slow down.

The arrival sequence design to and through a site contribute to the project's identity, including the visitor's orientation to the site and route to reach their destination. The circulation routes, signage, checkpoints, control of site lines (screening or emphasizing views of certain areas), and topography all contribute to the arrival process and legibility of the site. The establishment of circulation and access points may differentiate between entries and routes for pedestrians, staff, visitors, deliveries and service, each with differing security requirements to be satisfied.

Unit IX-C-10



Access Points

Gatehouses, lobbies, and guard posts should be provided with clear views of approaching traffic -- pedestrian and vehicular. Screening areas and entries may be located to offer more privacy and protection.

It is advisable to design circulation to separate different types of traffic and provide separate routes for staff, for visitors, and for deliveries. With the separation of vehicle types, security can more easily address differing needs for screening, observation, and potential threat mitigation.

Location selection for vehicular access and entry control for a building starts with an evaluation of the anticipated demand for access to the controlled site. An analysis of traffic origin and destination, and an analysis of the capability of the surrounding connecting road network, including its capacity to handle additional traffic, should then be performed. Expansion capacity

Roadway network design that uses straight-line approaches to buildings may give approaching vehicles the opportunity to gather the necessary speed to ram protective barriers and crash into buildings. Possible solution: design approaches to be parallel to the façade, with berms, high curbs, trees, and other measures used to prevent vehicles from departing the

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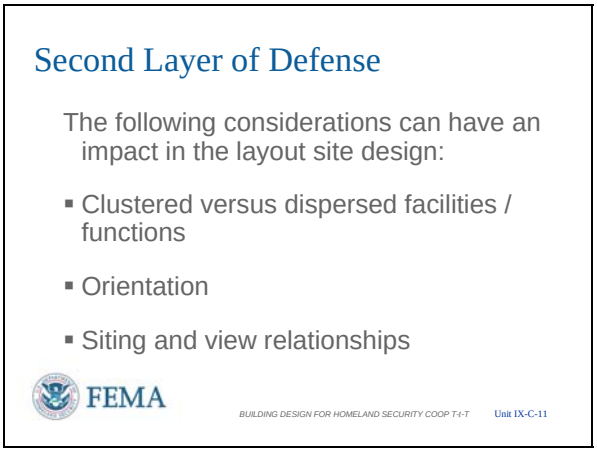
should also be considered. The analysis should be coordinated with the state and local departments of transportation.

Two security measures that are overlooked are: First, allowing the vehicle to enter the site so that it can turn around and leave. A proper entry control point would never allow the vehicle to enter the site if it were not authorized. Second, there are multiple reaction times that must be added – guard recognition that vehicle is avoiding security, guard reaction to activate final barriers, and activation time from closed to open for the final barriers. The time delay from recognition to deployment must be less than the speed of the vehicle between the recognition point and the final barrier.

Unit IX-C-11



roadway.

The existing terrain can have a significant impact on the suitability of a potential entry control point site. Flat terrain with no thick vegetation is generally preferred. A gentle rise in elevation up to the entry control guard building allows for a clear view of arriving vehicles. Consider how existing natural features such as bodies of water or dense tree stands may enhance perimeter security and vehicle containment, without restricting observation capability or allowing easier surveillance of the building by potential threat elements. Entry control spatial requirements vary, depending on the type, the traffic demand, and the necessary security measures.

Second Layer of Defense

The following aspects of the building program and layout impact the site design and assessment:

- Overall size and number of structures placed on site with high-risk buildings clustered together for increased security or stand-off or dispersed to devalue as a target.
- Orientation of buildings to reduce damage from bomb blast and prevent direct approaches by high speed vehicles.
- Increase views of approaches to the building, but screen views from outside surveillance.

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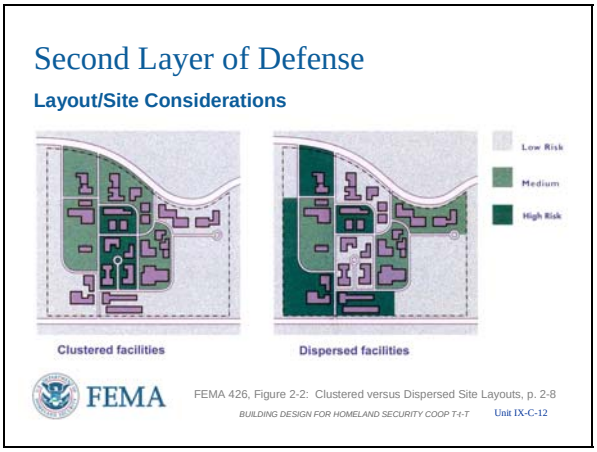
Unit IX-C-12

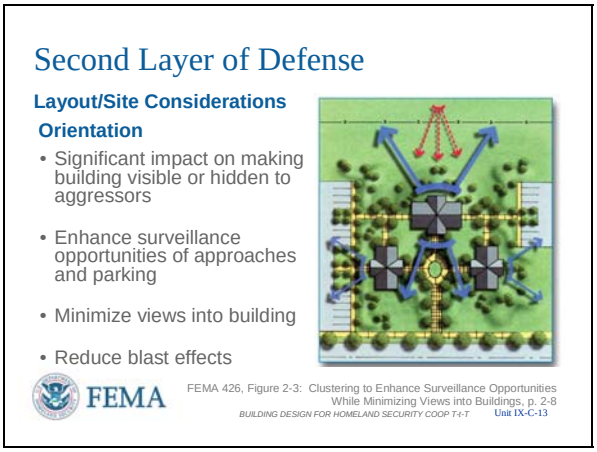


Layout / Site Considerations – Clustered versus Dispersed Facilities

Depending on the site characteristics, the occupancy requirements, and other factors, buildings may be clustered tightly in one area, or dispersed across the site. Both patterns have compelling strengths and weaknesses.

Concentrating people, property, and operations in one place creates a target-rich environment, and the mere proximity of any one building to any other may increase the risk of collateral impacts. Additionally, the potential exists for the establishment of more single-point vulnerabilities in a clustered design than would exist in a more dispersed pattern. However, grouping high risk activities, concentrations of personnel, and critical functions into a cluster can help maximize stand-off from the perimeter and create a "defensible space."

Unit IX-C-13



Layout / Site Considerations -- Orientation

Orientation is the building's spatial relationship to the site, its orientation relative to the sun, and its vertical or horizontal aspect relative to the ground.

- How many times have you seen aluminum foil on windows because the afternoon summer sun overcomes the air-conditioning capacity along that side of a building?

The physical positioning of a building relative to its surroundings may seem subtle, but can be a greater determinant of security.

Good site design, orientation, and building placement should allow building occupants to look out of the facility while minimizing views into the building.

The proximity of a vulnerable façade to a parking area, street, adjacent site, or other area

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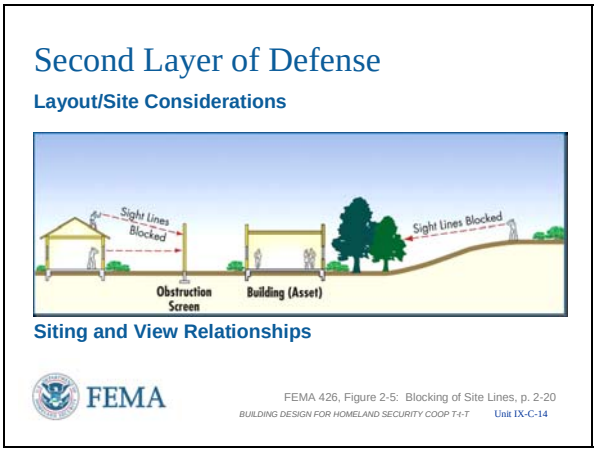
that is accessible to vehicles and/or difficult to observe can greatly contribute to its vulnerability.

Unit IX-C-14



Layout / Site Considerations – Siting and View Relationships

Landscape and urban design inherently define the "line of sight" in a space. Operational security is not a traditional element of master planning, but managing the threat of hostile surveillance is a significant consideration in protecting people, property, and operations. With careful selection, placement, and maintenance, landscape elements can provide visual screening that protects sensitive operations, gathering areas, and other activities from surveillance without creating concealment for covert activity.

These techniques seek to deny aggressors a "line of sight" to a potential target, either from on or off site. This increases the protection of sensitive information and inhibits operation of stand-off weapons. In addition to the use of various screening options, anti-surveillance measures (e.g., building orientation, landscaping, screening, and landforms) can also be used to block sight lines.

The design should maximize opportunities for internal surveillance of site perimeters and screening of internal areas from external observation. Topography, relative elevation, walls, and fences are design elements that can open and close views. Vegetation can open, close, or block views, not only for security purposes but also to provide beauty and to support wayfinding. As a rule of thumb, vegetation should be very high or very low, to keep views open. Vegetation at the base of buildings and structures should be designed and maintained to prevent explosives from being hidden from view – easily see a briefcase

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or a backpack.

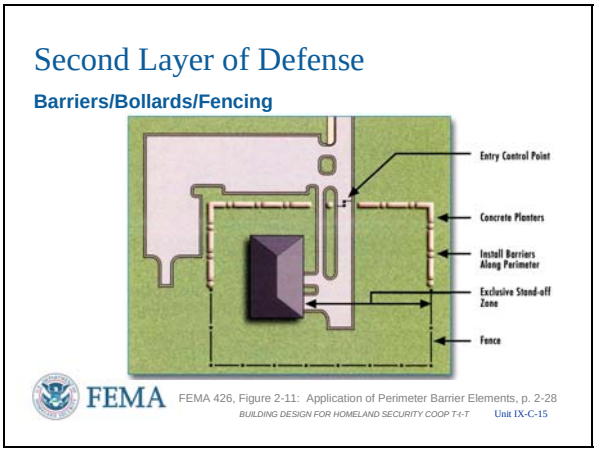
Landforms can have a direct bearing on the security of a facility. They can be either beneficial (e.g., an elevated site that may enhance the surveillance of the surrounding area), or detrimental to anti-surveillance.

Generally speaking:

- For security purposes, buildings should not be sited immediately adjacent to higher surrounding terrain or buildings if at all possible.

Unit IX-C-15

Barriers / Bollards /Fencing



A number of elements may be used to create a physical barrier, some natural and some manmade. Natural barrier elements include rivers, lakes, waterways, steep terrain, mountains, barren areas, plants, soft sand, and other terrain features that are difficult to traverse. Manmade elements include fencing, walls, buildings, bollards, planters, concrete barriers, and fountains. Selection of elements must consider the level of security desired and the type of threat most likely to occur.

When placing bollards, make sure you adhere to ADA (Americans with Disabilities Act) compliance.

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Unit IX-C-16
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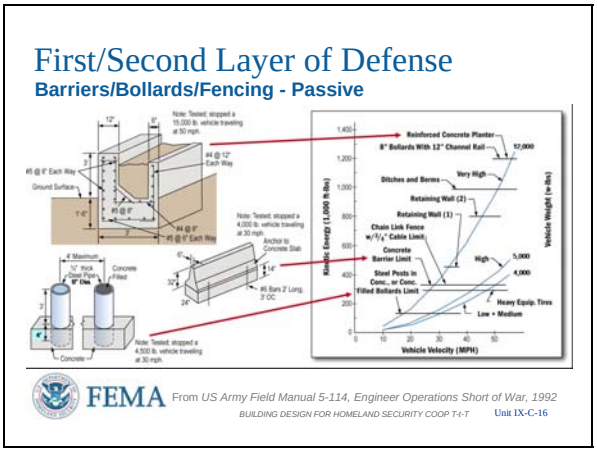

Discuss the mass (vehicle size) and vehicle speed in the chart. Note that since speed is squared (K.E. = ½ * mass * speed * speed), controlling speed is a primary concern.

Unit IX-C-17

Barriers / Bollards /Fencing – Passive Barriers

It is one thing to provide a passive barrier, it is another to ensure the barrier will provide the protection level sought. We have talked about controlling vehicle speed approaching access points and buildings. Essentially, any barrier will stop a given level of kinetic energy which is ½ mass * velocity squared. Thus, the bigger the vehicle and the higher its speed the stronger the barrier must be as shown by this chart.

The greater the barrier mass and reinforcement and the deeper it is connected to the earth, the higher its rating.

Notice the jersey barrier has the rating listed only if there are four rebar pinning the barrier at least 18 inches into pavement. Alternately, a 1-inch steel cable linking the jersey barriers would be an alternate technique, but with some penetration into the space being protected.

Barriers / Bollards /Fencing – Water Barriers

Water-filled barriers are another approach as they are lightweight and easy to deploy. The left photo shows the stopping power and the right photo shows water barriers that support a fence. Filling the barriers with sand make them less portable.

As with jersey barriers, linking the barriers with 1-inch steel cable improves their performance, due to the added mass of adjacent barriers contributing to stopping the vehicle. Also, these barriers must be checked periodically for leaks, especially if allowed to freeze when filled with water. Without water or sand these would lack critical needed mass.

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Unit IX-C-18
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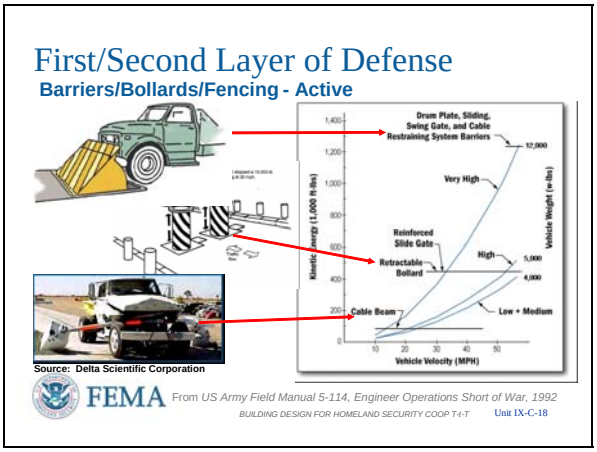


Barriers / Bollards /Fencing – Active Barriers

As with passive barriers, active barriers also have different levels of kinetic energy stopping power, based upon mass and connection to the earth.

The advantage of active barriers is that access points and building access to loading docks or for maintenance can allow vehicles to pass or not pass based upon authorization.

One company is marketing a turntable that allows the fixed bollards to be turned 90 degrees to the vehicle path, then rotated back to block vehicle traffic.

Unit IX-C-19

Barriers / Bollards /Fencing – Active Barriers

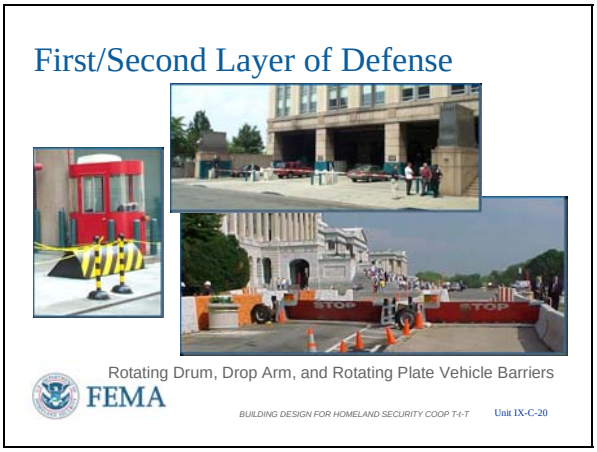
These photos show retractable bollards stopping a substantial truck with very little penetration.

An active barrier can be activated in seconds (1 to 3) and should be either always up (sally port concept) or deployed upon identification that the gate is being crashed (taking into consideration response time, maximum vehicle speed and activation speed/time.

Pop-up barriers can create serious damage to vehicles, especially if deployed when a vehicle is above the barrier. Consider manual activation to avoid unnecessary damage (avoid magnetic vehicle loops to redeploy a barrier that will catch a tailgating vehicle).

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-20



Barriers and Street Closure

In alleys and typical urban streets adequate stand-off distance is an impossibility without street closure. This is generally undesirable because of the disruption caused to traffic patterns.

The top and left photos show permanently installed barriers, while the bottom right photo shows temporary barriers that can be rapidly deployed and moved into position to control site and parking access, control traffic flow, and provide stand-off distance for buildings.

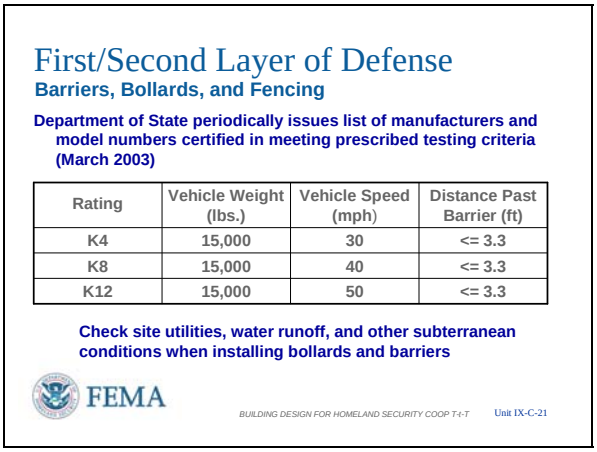
Improvised closures tend to destroy the attractiveness of the street with a combination of security personnel and ugly temporary barriers. Configuration for access, queuing, and inspection shout be planned in any case to reduce potential problems by reducing circulation and aggregated space in a city.

Full closure is often impossible because of the need for service entry. Temporary closure can be achieved by active or manual barriers, combined with public works and security personnel.

Consider the “Ring of Steel” being installed in a core area of London, England. It acts as a first layer of defense, inspecting, restricting, and documenting all vehicles that enter the core area to keep larger weapons out.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-21

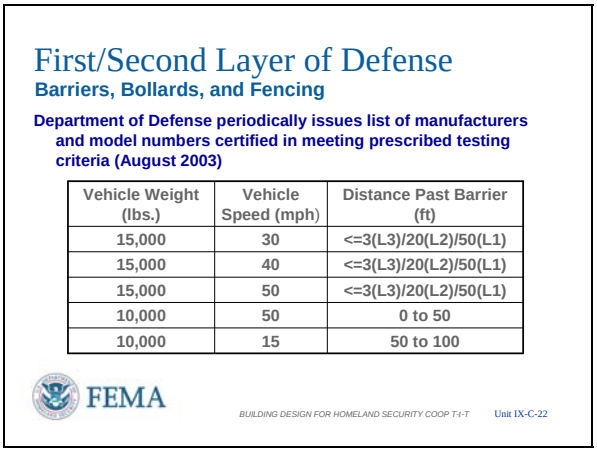


Department of State Barrier Ratings

Department of State barrier ratings are probably more suitable to an urban environment where stand-off is limited -- the 3.3 feet distance allowed past the barrier is for the leading edge of the cargo area of the truck (where the bomb is most likely being carried).

Also, Department of State has found that diesel trucks have greater penetration capability, so their tests now require the use of diesel trucks vice gasoline powered trucks.

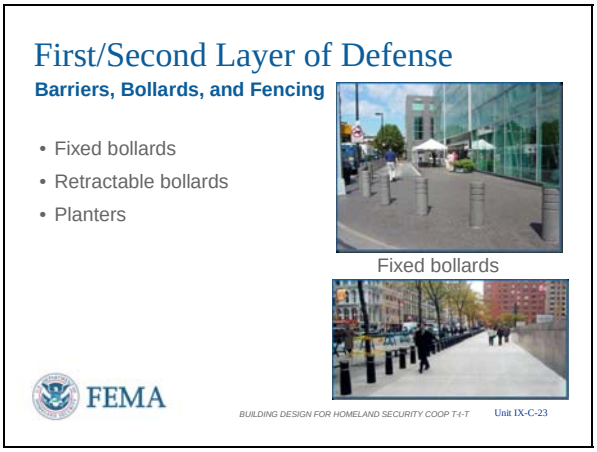
Unit IX-C-22
Hidden Slide



Department of Defense Barrier Ratings

Department of Defense barrier ratings use the old Department of State criterion that allows the front of the vehicle to penetrate a given distance past the barrier. This would be more suitable in a suburban environment where there is greater distance between the barrier and the nearest building than in the urban environment.

Unit IX-C-23



Barriers / Bollards /Fencing – Bollards and Planters

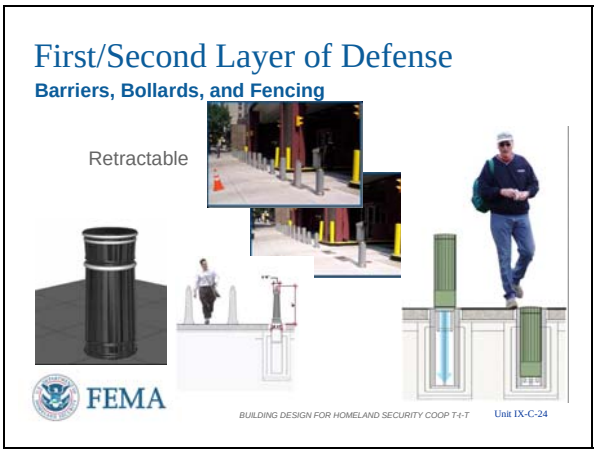
Sidewalks serve as the common space for pedestrian interaction, movements, and activity.

Extending barriers into sidewalks, streets or parking lanes may provide additional stand off distance. While this is technically possible, this approach often creates negative impacts within the public realm, which may make this an unfeasible solution. Be sure that introduced security measures are effective.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Bollards and other barriers are ideally the first layer of defense in the urban environment so as to obtain the most stand-off possible.

Unit IX-C-24



Barriers / Bollards /Fencing -- Retractable Bollards

Retractable bollards are an excellent (though expensive) solution when the use of security elements is critical and the width of the street does nor allow their permanent placement.

Effective bollards must be carefully engineered with deep foundations and the additional depth required for retracting may cause problems with underground utilities and services, building basements extending under sidewalks in urban areas, and other structures that may exist under sidewalks that affect retractable bollard performance.

Unit IX-C-25

Barriers / Bollards /Fencing -- Planters

Bollards and planters can help create an appealing streetscape depending upon their design and the current environment in which they are installed.

When placed, make sure that they accomplish their function and distance between them is appropriate. The distance must allow free flow of pedestrians, but restrict flow of vehicles.

Fragmentation is another concern with any barrier system, whether caused by bomb blast or vehicle impact.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-26

Barriers / Bollards /Fencing -- Jersey Barriers

Least desirable of barrier types

- Difficult to place and move
- No vehicle stopping capability unless tied to pavement with at least 4 pieces of #4 (1/2-inch diameter) rebar into pavement about 18 inches deep and/or tied together with steel cable (3/4 to 1-inch)
- Can cause sidewalk failure due to concentrated load and fact that sidewalk may be hollow underneath for storage or utilities
- Adds to fragmentation (barrier shatters) if vehicle bomb explodes next to barrier
- They impede access – pedestrians and first responders
  - Utilities (if placed on top of manholes)
  - Emergency access (fire trucks, ambulance, police)
  - ADA (Americans with Disabilities Act) access – crosswalks and ramps

Unit IX-C-27

Barriers / Bollards /Fencing -- Bollards

When placed, make sure that they accomplish their barrier function with an appropriate distance of not less than 4 feet-between them.

Bollards placed in long unbroken rows present a monotonous appearance and may appear as a wall from some angles.

<u>Pay attention</u> to how bollards or fences:

- Turn the corner
- Intersect with driveways and gates
- Cross pedestrian paths and handicapped ramps

In an urban environment, bollards and barriers are ideally the first layer of defense to obtain the most stand-off possible.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

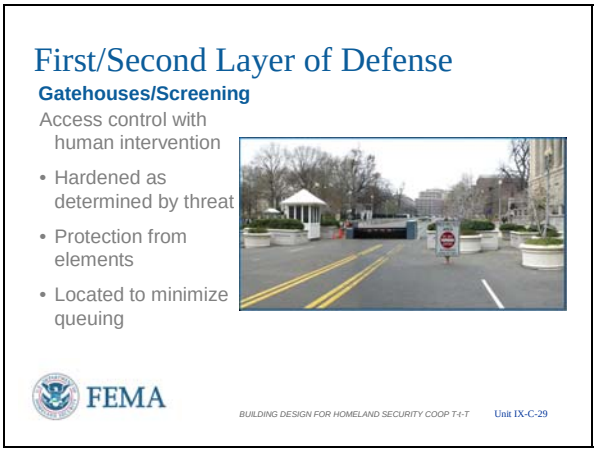
Unit IX-C-28

Barriers / Bollards /Fencing -- Fencing

Fencing can cover the range from being limited to channeling law-abiding people (pedestrians and vehicles) to being massive constructions with the intent of controlling malicious people and vehicles.

As a basic it provides access control for pedestrians and vehicles (usually with the help of other barriers). Fencing in each layer of defense is enhanced with electronic security – sensors and CCTV.

Unit IX-C-29



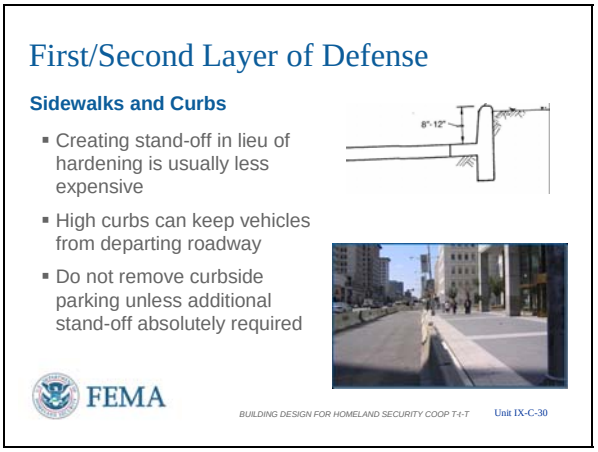
Gatehouses / Screening

Gatehouses are to assist the screening of vehicles and pedestrians to ensure they have proper authorization for access. This can be at the first layer of defense (normally) or at any restricted perimeter.

- Depending on the threat the gatehouse should be hardened, but at the very least PPE (personal protective equipment, like bullet-resistant vests) should be worn
- The elements – wind, rain, heat, cold make this job difficult enough that the gatehouse should provide a refuge with water, heat, and air conditioning, including a rest room
- Proper placement so that the guard can interact with drivers without having to cross the traffic lane and adequate throughput so that queues will not form waiting for access.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-30



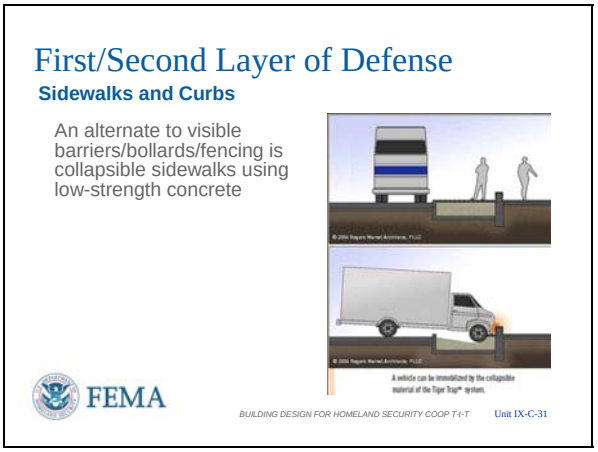
Sidewalks and Curbs

Sidewalks serve as the common space for pedestrian interaction, movements, and activity. Sidewalks should be open and accessible to pedestrians to the greatest extent possible and security elements should not interfere with circulation particularly in crowded locations

Curbside parking should not be removed unless additional stand-off distance is absolutely necessary for high-risk buildings. Prohibiting on street parking or closing lanes should only be used as a temporary measure during times of increased alert.

High curbs and other measures may be installed to keep vehicles from departing the roadway (especially if curb height is at the axle height, but ensure ADA requirements are met at intersections). In one instance, an armored car firm was asked to park their vehicles around a building that had received credible threats to act as barriers and increase stand-off.

Unit IX-C-31



Sidewalks and Curbs

Another unobtrusive approach for providing a vehicle barrier is combining collapsible sidewalk with a small wall that will catch a vehicle bumper. The sidewalk is made of low-strength concrete that takes pedestrian weight but not vehicle weight.

These graphics are of the Rock Twelve Security Architecture Tiger Trap ™ and their product literature information:

- Designed to reduce the impact of security on public space, this innovative vehicle arrest system utilizes a subgrade compressible material that lowers the elevation of an attacking vehicle and a

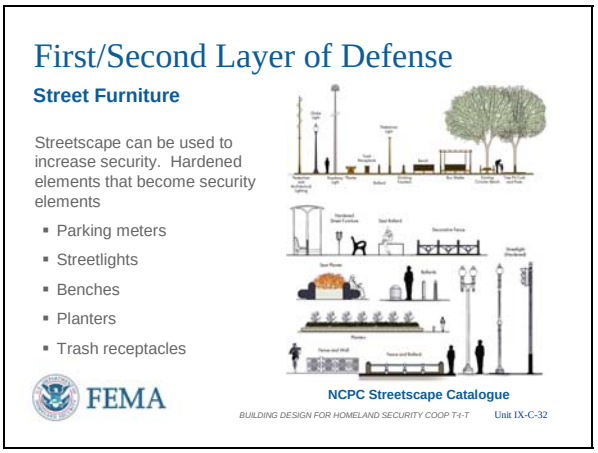
INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

low wall that then halts the lowered vehicle.

- The subgrade compressible material allows the rear wall to be as low as a bench or even completely below grade.

- The compressible material combined with a decorative covering surface supports pedestrian loads, but fails under the weight of a vehicle.

Unit IX-C-32



Street Furniture

At the site perimeter, walls and fences may be hardened (strengthened) to resist the impact of a weapon-laden vehicle. However, planters, bollards or decorative boulders can accomplish the same objective in a much more aesthetically pleasing manner.

The streetscape can included hardened versions of parking meters, street lights, benches, planters and trash receptacles that act as barriers to moving vehicles.

The National Capital Planning Commission (NCPC) provides a catalog that shows several examples of hardened streetscape furniture.

Unit IX-C-33

Street Furniture

The scale of the streetscape should be appropriate to its primary users and it can be manipulated to increase the comfort level of desired users while creating a less inviting atmosphere for users with malicious intent.

It is critical to maintain important functions such as adequate space for pedestrian circulation and appropriate distances between vehicles and security barriers. The recommended distance to place streetscape security components is at least 24 inches from

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

the edge of the curb to allow for the opening of car doors and pedestrian movement from car to sidewalk.

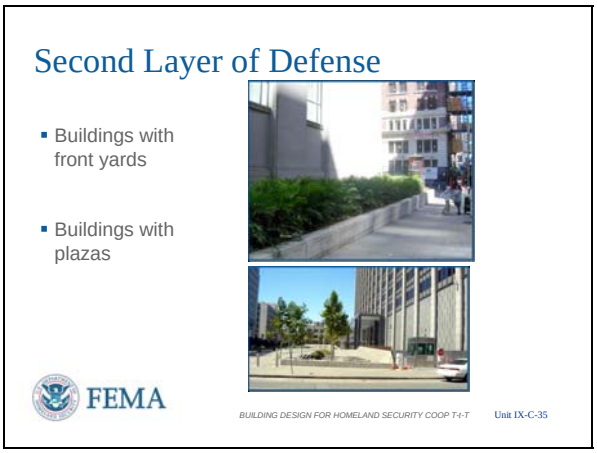
Well planned barriers can also assist in clearly defining areas of public and private space and in protecting pedestrians from traffic.

Unit IX-C-34
Hidden Slide

Street Furniture

Numerous urban design elements present opportunities to provide security. Even at the pedestrian scale, certain operational requirements must be accommodated. For example, although efficient pedestrian and vehicle circulation systems are important for day-to-day living, they are also critical for emergency response, evacuation, and egress. Furthermore, despite an emphasis on downsizing the scale of the streetscape, it is critical to maintain the maximum stand-off distance possible between vehicles and structures.

Unit IX-C-35



Yards and Plazas

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

- Buildings with zero setback and alleys. The building face is on the property line. An alley is a narrow street that divides a city block and provides service access to the side or rear of the building.
- Buildings with front yards. The building is set back from its property line and the space is usually landscaped. The building yard includes pedestrian entries and loading docks.
- Building with plazas. The building is placed within an open space that is publicly accessible.

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Unit IX-C-36

Building Yard

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 typical, narrow, of the order of 10 to 20 feet, providing some stand-off distance.

The yard may be flush or raised above the level of the sidewalk. A raised yard can provide a barrier to vehicles.

Major public buildings may have wide yards that are more of a landscaped forecourt that can offer reasonable stand-off distance. Yards are usually provided for governmental or institutional buildings in which coverage of the entire property may not be economically critical as is the case for private development.

Sometimes small yards (within the property line) are matched with a wide sidewalk provided by the city.

Unit IX-C-37

Building Yard

A typical raised, low planter that can act as a bench (or plinth wall that holds back soil or rock), as shown in the left photo, presents a significant barrier to small and medium-sized vehicles. The high stepped yard in the right photo, which is along the side of the building, is a significant barrier and could also act as a deflector of explosive blast from a curbside vehicle bomb.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

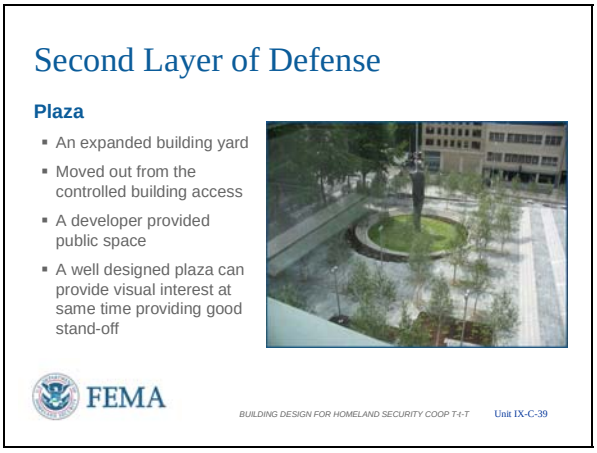
Unit IX-C-38

Building Yard

Security elements within the building yard should complement the building architecture and landscaping and should be designed so as to appear as well designed landscape objects rather than expressing security. The security elements should be located near the outer edge of the yard to maximize stand-off.

Good examples of this are shown in these photos.

Unit IX-C-39



Plaza

Extensive business district development with very large buildings began after World War II. The straight tower with no setbacks became fashionable, but new ordinances permitted building developers to construct taller buildings, with greater floor area, if a public plaza was incorporated. In fact, in Tokyo, new high-rises must ensure they do not completely block the sun from surrounding buildings.

In effect, the plaza became an expanded building yard. It was moved outside the controlled access space of the building and became public space provided by the developer.

The additional space provided by plazas enables a more effective second layer of defense to be achieved. Often an acceptable stand-off distance can be created on one or more faces of the building depending on the plaza /building layout.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

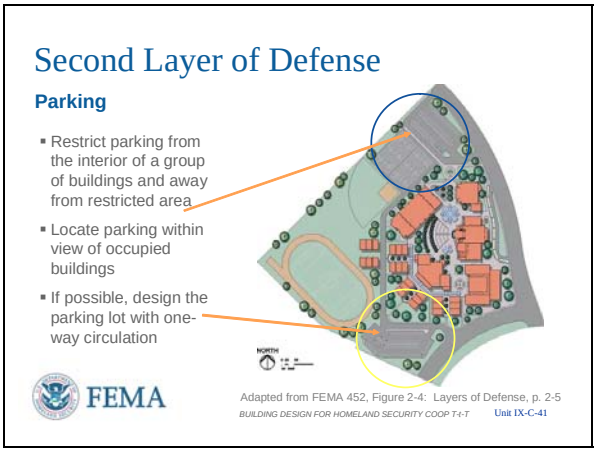
Unit IX-C-40

Roadways

Given that the energy transferred when one object strikes another is a function of its mass and its velocity, a bollard that can stop a 15,000-pound truck moving at 35 miles per hour may not be able to stop the same truck moving at 55 miles per hour. In developing a system of street alignments with protection in mind, the designer cannot determine the size or weight of a vehicle that will travel along the road. However, the designer can propose a roadway system to minimize vehicle velocity, thus using the roadway itself as a protective measure.

Minimizing street closure and disrupting vehicle and pedestrian patterns should always be a goal. But at higher threats, these measures may be among the few available mitigation options.

Unit IX-C-41



Parking

Building placement on the site must balance stand-off distances; relationship to adjacent streets and buildings; siting of utilities, parking areas, and driveways; as well as access to parking and loading areas.

There are three primary types of parking facilities, all of which present security trade-offs.

- Surface lots can be designed to keep vehicles away from buildings, but they consume large amounts of land and, if constructed of impervious materials, can contribute greatly to stormwater runoff volume. They can also be hazardous for pedestrians if dedicated pedestrian pathways are not provided.
- In contrast, street parking is often convenient for users and a source of revenue for local governments (parking meters), but

INSTRUCTOR NOTES	CONTENT/ACTIVITY

this type of parking may provide little or no setback.

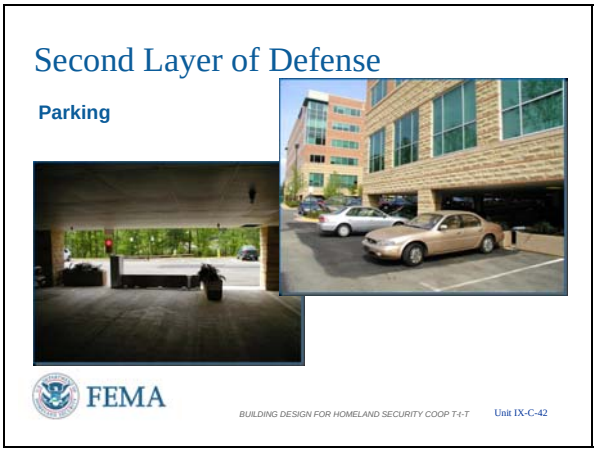
- Finally, garage structures provide revenue and can be convenient for users, but they may require structural measures to ensure blast resistance as well as crime prevention measures to prevent street crime.

Although the cost of land suggests that the construction of a garage (either underground or aboveground) may be the most economically viable approach for many developments, they can be highly vulnerable to vehicle-borne weapons, endangering the building above in the most commonly found configuration. If garages must be used, human security procedures (e.g., vehicle searches) and electronic systems (e.g., closed circuit television) may be necessary.

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

If stand-off distance is needed between a building and a First Layer controlled perimeter, placing parking in this area is an excellent use of the available space, as shown in this graphic.

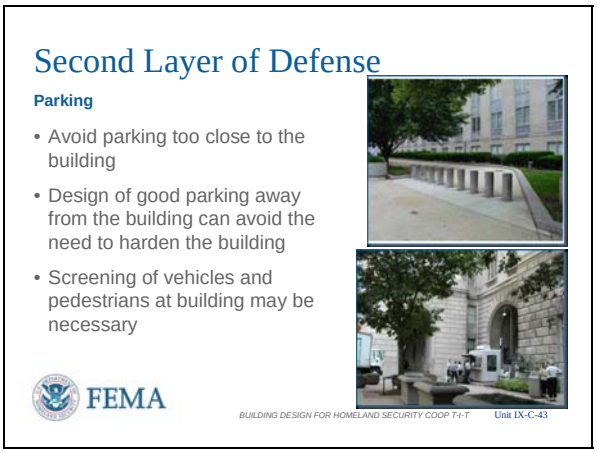
INSTRUCTOR NOTES	CONTENT/ACTIVITY
Unit IX-C-42	**Parking**



Parking layout and circulation is often one of the largest program elements in site design. Public street parking, parking lots, free standing structured parking buildings, and underground parking have different characteristics to be considered.

Note the limited physical barriers that are in place to prevent unauthorized vehicles from getting underneath this building as shown in the slide. Also note the limited stand-off and the parking proximity to columns supporting the exterior wall of the building.

Unit IX-C-43
Hidden Slide



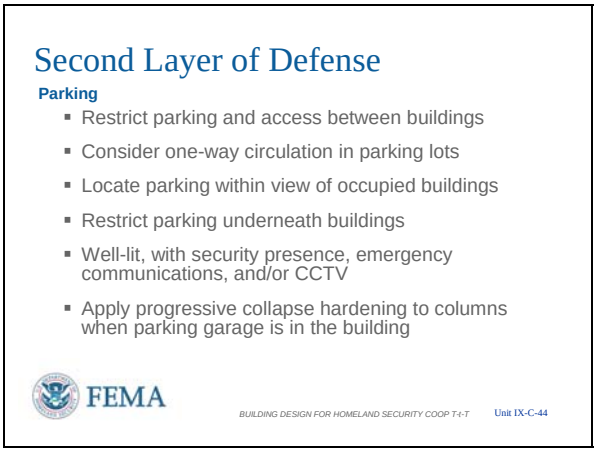
Parking

Avoid parking too close to the building, especially large vehicles.

Good parking design can prevent the need to harden the building.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-44

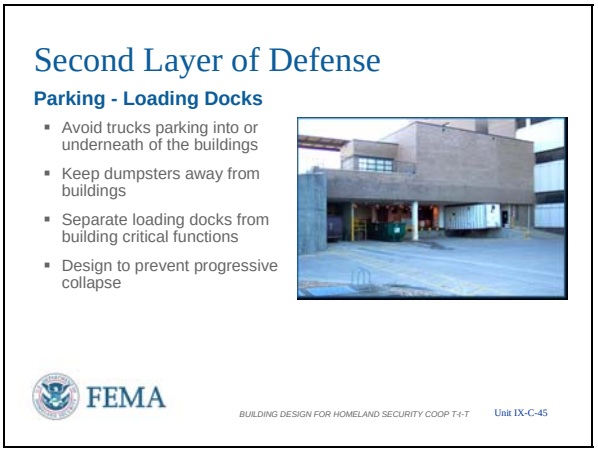


Parking

When designing parking, the following should be taken into consideration:

- Maintain stand-off distance from building
- Restrict parking from the interior of a group of buildings and away from any restricted area
- Avoid having parking near, within or underneath buildings – Consider hardening against progressive collapse if parking garage is in the building.
- Locate parking within view of occupied buildings
- If possible, design the parking lot with one-way circulation that restricts straight-on high-speed approaches to buildings
- Provide signage to clearly mark separate entrances for different parking lots
- Keep parking areas well lit; use emergency communications, and/or CCTV

Unit IX-C-45



Significant structural damage to the walls and ceiling of the loading dock may be acceptable; however, the areas adjacent to the loading dock should not experience severe structural damage or collapse.

Parking – Loading Docks

Loading docks and service access areas are commonly required for a building and are typically desired to be kept as invisible as possible.

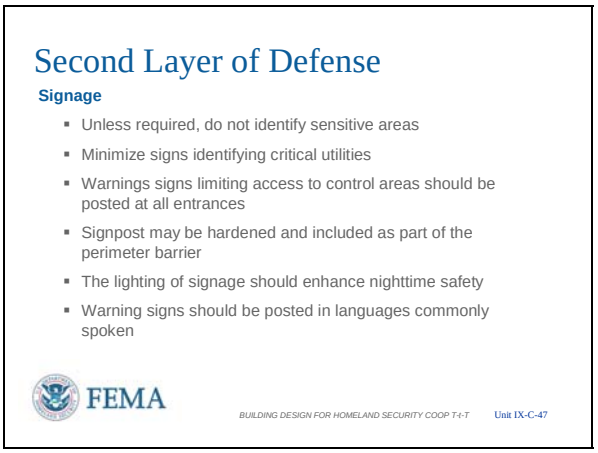
- Locate loading docks so that vehicles will not be allowed underneath the building or too close to the building at the curb lane. If this is not possible, the dock area should be hardened for blast.
- Design to prevent progressive collapse, especially if loading dock is under the building.
- Separate (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,

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

This photo is a good example of a loading dock that is not underneath the building. This will be covered in more detail in the next instruction unit.

Unit IX-C-46

Unit IX-C-47



Whatever the strategy for signage, it is important that signage be developed in concert with other site design elements, be included in the site design palette, and

fire suppression water mains, cooling and heating mains, etc.

- Siting and layout of loading areas should be secured and accommodate sufficient area for screening vehicle and packages.
- Trash dumpsters should be relocated away from the building. (Explosive devices can be tossed in the dumpster creating a blast effect.)

Parking – Loading Docks

Loading dock on-site accommodation is essential. Security issues relating to loading docks must be examined on a site by site basis, possibly involving the cooperation of civic authorities, especially in an urban environment.

For increased threat levels, you may coordinate local policy to screen vehicles before approaching the loading dock. In any case, the vehicles need an inspection area established for normal operations at lower threat levels in order to protect the building.

Signage

Building owners should determine how visible the project should be and corresponding implications for site signage. For some projects, a degree of anonymity may be part of the security strategy.

- Unless required, signs should not identify sensitive areas.
- Minimize signs identifying critical utility complexes, such as power plants and water treatment plants.
- Warning signs should be posted at all entrances to limited, controlled, and exclusion areas.
- The wording on the signs should denote warning of a restricted area.
- Signs should be posted at intervals of no

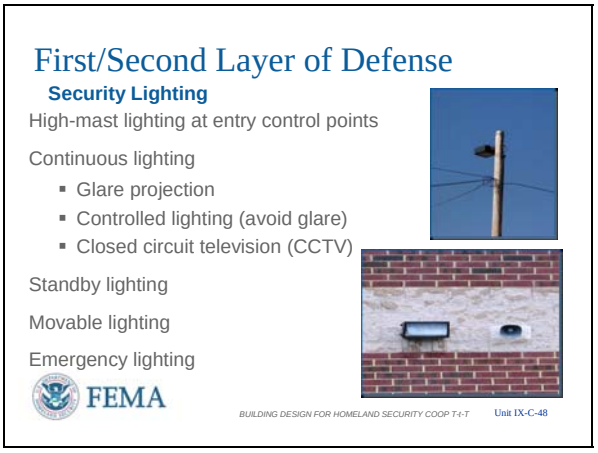
INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

designed and placed in coordination with all other materials. To reduce the potential of clutter, signage should be integrated with other streetscape elements and architectural elements. Access, maintenance, and adaptability should be considered in selection of signage systems. Periodically changes are required to signage content. A comprehensive signage plan should be tailored to the mission of the facility accompanying the FEMA 426 guidelines.

more than 100 feet and should not be mounted on fences equipped with intrusion-detection equipment.

- Signage may be mounted on other elements, such as fences and walls to reduce the number of posts along the street or perimeter.
- Signposts may be hardened and included as part of the perimeter barrier.
- The lighting of signage may also enhance nighttime safety to those who come to the site during evening or early morning hours.
- Locate variable message signs, which give information on site/organization special events and visitors, so that they are not observable from site perimeters (first layer)
- Warning signs must use languages commonly spoken.

Unit IX-C-48



Security Lighting

Security lighting should be provided for overall site and building illumination and along the perimeter to allow security personnel to maintain visual assessment during darkness. Lighting is desirable around areas such as piers, fence lines, loading docks, storage areas, and parking lots. At entry points, a recommended minimum surface lighting average of 4 horizontal foot candles will help ensure adequate lighting.

Security lighting has different purposes – to blind, to allow vehicle inspection, to identify credentials, to support CCTV capabilities, etc. Thus, security lighting must be coordinated for all purposes.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-49

Sensors / CCTV

Manned and electronic security increases deterrence and detection with attendant reduction in risk. It is the fastest technology to add and upgrade when selected, installed, and used properly.

It should cover vehicle, pedestrian, and utility entrances as all of these are potential approaches for terrorist tactics.

This will be covered in more detail under Electronic Security Systems later.

Unit IX-C-50

A thorough walk-through of the site property should be conducted and proper protection devices should be applied to exposed utilities. The electrical substation shown can be easily damaged from outside the fenceline by projectiles or short circuiting actions. The structure on the right only has fencing on three sides.

Site Utilities

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.

Loss of a utility because access was readily available to a potential threat element is one reason for assessing site utilities to ensure physical security measures are in place to limit access to authorized personnel only.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-51

Site Utilities

- Top Right – Open Gate allowing access to Critical Cooling Unit for Computer Center
- Lower Right – Exposed air conditioning systems
- Middle – antenna system for Emergency Operations Center accessible from the ground
- Lower Left – Exposed generator and natural gas regulators

Concealed or underground utilities are easier to protect than exposed or aboveground constructions.

Access to utilities should be protected or secure, allowing only authorized personnel access to perform maintenance and repair.

If physical security measures cannot limit access, then add sensors/CCTV to provide added protection.

The location and accessibility of site utilities directly impacts the vulnerability of systems to disruption and failure.

Incoming utility systems should have two entry points to the site for redundancy as required by criticality.

Looped versus radial distribution of utilities on site allows for higher system reliability and faster repair by avoiding utility loss by a single incident.

When selecting locations for utilities, be aware of possible conflicts and spacing requirements both horizontally and vertically. In addition there can be demand for underground zones for planting beds and foundations for hardened street furniture.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-52
Hidden Slide

Site Utilities

The U.S. utility infrastructure is highly concentrated, utilizing the same rights-of-way, tunnels, underground conduits, and other service points. Examine where the utilities intersect (manholes, poles, city blocks, etc.) to find critical nodes.

Even if the utility is underground, manholes that provide access to the system should be physically secured.

Install fencing and if possible, remote monitoring capability at key electrical substations, pumping plants, and communications vaults.

Unit IX-C-53
Hidden Slide

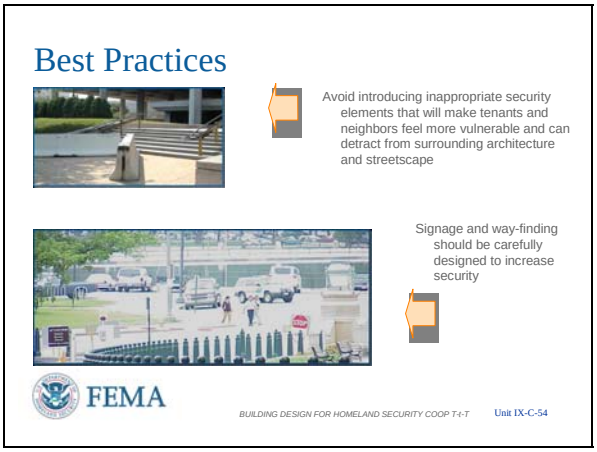
Best Practices

Best practices include but are not restricted to the following:

- Appropriate design can blend security into the existing streetscape and serve as amenities for tenants and neighbors
- Treatment of the security elements should be compatible existing elements – so that they do not look like security elements
- Perimeter barriers can be hand-in-hand with streetscape improvements and street planting
- Careful design attention should be paid to how bollards or fences turn the corner, intersect with driveways and gates, cross pedestrian paths and handicapped ramps
- Avoid street closure and removal of parking as the only solution of establishing stand-off distance
- Landscaping can provide visual interest and at the same time provide good stand-off

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

Unit IX-C-54
Hidden Slide

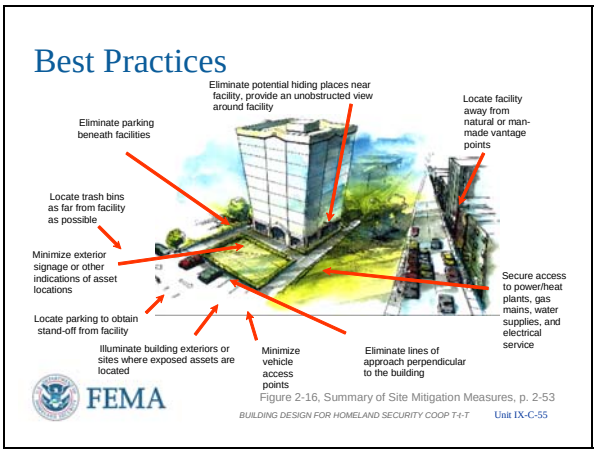


Best Practices

Good examples to follow and bad examples to avoid:

- Avoid introducing inappropriate security elements that will make tenants and neighbors feel more vulnerable and can detract from surrounding architecture and streetscape – jersey barrier at entrance steps – also ineffective as placed directly on pavement
- Signage and way-finding should be carefully designed to increase security
- Long expanses of bollards should be carefully designed and sited to avoid monotony – as can be seen in the lower photo
- Use perimeter barriers to define pedestrian zones and increase the safety of pedestrian by separating them from vehicular traffic
- Avoid designing perimeter barriers that impair access by first responders

Unit IX-C-55



Page 2-52 of FEMA 426 provides a comprehensive list of security/protection measures that can be taken – increasing in *protection, cost, and level of effort* – that

Best Practices

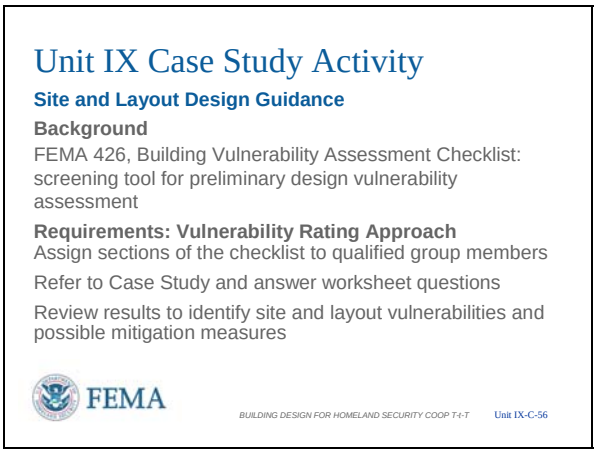
To summarize:

- A broad spectrum of mitigation actions can be taken – with a wide range of cost, protection provided, and level of effort required by the asset owner.
- The nominal ranking of mitigation measures on Page 2-52 provides a framework for the identification of short-term and long-term measures that can be taken.
- This is a great summary slide and can be found in FEMA 426 and the Air Force Installation Force Protection Guide on your Student Reference CD.

INSTRUCTOR NOTES | **CONTENT/ACTIVITY**

complements this graphic on Site Mitigation Measures.

Unit IX-C-56



Refer participants to **FEMA 426** and the Unit IX Case Study activity in the Student Manual.

Members of the instructor staff should be available to answer questions and assist groups as needed.

There are 29 questions to answer by the team and then confer. With an average of 7 team members this means each member answers about 4 questions or about 7 minutes per question during their 30 minutes of research.

Student Activity

The **Building Vulnerability Assessment Checklist in FEMA 426** can be used as a screening tool for preliminary design vulnerability assessment or for assessing an existing site. The checklist includes questions that determine if critical systems will continue to function to enhance deterrence, detection, denial, and damage limitation, and if emergency systems will function during a threat or hazard situation.

Activity Requirements

- Continue working in your small groups.
- Assign sections of the checklist to the group member who is most knowledgeable and qualified to perform an assessment of the assigned area.
- Refer to the Case Study to determine answers to the worksheet questions.
- Then review results to identify vulnerabilities and possible mitigation measures.

Take 45 minutes to complete this activity broken down as 30 minutes of research and 15 minutes of group interaction to compare information and discuss mitigation measures. Solutions will be reviewed in plenary group, taking about 15 minutes to ensure no group is drastically off track.

Transition

Unit IX covered the First and Second Layers of Defense.

Unit X will cover Building Design Guidance which includes the Third Layer of Defense.

UNIT IX (C) CASE STUDY ACTIVITY: SITE AND LAYOUT DESIGN GUIDANCE (COOP Version)

In this student activity, the emphasis is identifying vulnerabilities in the site and layout design. The **Building Vulnerability Assessment Checklist in FEMA 426 (Table 1-22, pages 1-46 to 1-93)** provides a tool for vulnerability assessment of the proposed and existing sites and buildings.

Requirements

Assign sections of the checklist to group members who are most knowledgeable and qualified to perform an assessment of the assigned area. Refer to the Appendix C Case Study to determine answers to the questions. Then review results as a team to identify vulnerabilities and possible mitigation measures.

Activity # 1: Complete the selected vulnerability checklist questions in the following Vulnerability Questions table.

> **Note**: There are **29** questions below (**13** in Section 1, **5** in Section 2, and **11** in Section 5), so it is recommended that the team split up the questions among themselves taking 3-5 questions each and review the Appendix C Case Study for answers. Apportion the available time for gathering the answers and then provide each other the answers while performing the actions below.

Activity # 2: Upon completion of the questions refer back to the vulnerability ratings determined in the Unit IV (C) Student Activity. Based on this more detailed analysis, decide if any vulnerability rating needs adjustment. Adjust the Risk Matrix poster accordingly for any changes in vulnerability rating.

Activity # 3: Select mitigation measures to reduce vulnerability and associated risk from the site and layout perspective. Concentrate on the three highest risk ratings on the Risk Matrix poster as adjusted by Activity # 2. Use the Site and Layout Design Mitigation Measures table found at the end of this unit to capture this information.

Activity # 4: Consider the mitigation measures of Activity #3 to be installed, estimate the new vulnerability ratings as if these measures were in place, and calculate the new risk ratings. Capture your information in the Site and Layout Design Mitigation Measures table.

Section	Vulnerability Question	Guidance	Observations
1	**Site**		
1.1	What major structures surround the facility (site or building(s))?	**Critical infrastructure to consider includes: Telecommunications infrastructure** Facilities for broadcast TV, cable	***There are two large manufacturing plants with large quantities of hazardous materials stored on site within 2 miles of the***

Section	Vulnerability Question	Guidance	Observations
	What critical infrastructure, government, military, or recreation facilities are in the local area that impact transportation, utilities, and collateral damage (attack at this facility impacting the other major structures or attack on the major structures impacting this facility)?	TV; cellular networks; newspaper offices, production, and distribution; radio stations; satellite base stations; telephone trunking and switching stations, including critical cable routes and major rights-of-way **Electric power systems** Power plants, especially nuclear facilities; transmission and distribution system components; fuel distribution, delivery, and storage **Gas and oil facilities** Hazardous material facilities, oil/gas pipelines, and storage facilities **Banking and finance institutions** Financial institutions (banks, credit unions) and the business district; note schedule business/financial district may follow; armored car services **Transportation networks** Airports: carriers, flight paths, and airport layout; location of air traffic control towers, runways, passenger terminals, and parking areas Bus Stations Pipelines: oil; gas Trains/Subways: rails and lines, railheads/rail yards, interchanges, tunnels, and cargo/passenger terminals; note hazardous material transported Traffic: interstate highways/roads/tunnels/ bridges carrying large volumes; points of congestion; note time of day and day of week Trucking: hazardous materials cargo loading/unloading facilities; truck terminals, weigh stations, and rest areas Waterways: dams; levees; berths and ports for cruise ships, ferries, roll-on/roll-off cargo vessels, and container ships; international (foreign) flagged vessels (and cargo) **Water supply systems** Pipelines and process/treatment facilities, dams for water	***CI/BC building, one to the north and the other to the southwest. In addition, there are more than a dozen Tier II HazMat facilities within 3 miles of the building (in all directions).*** ***A major interstate highway is located within ¼ mile of CI/BC.*** ***CSX Transportation and Norfolk-Southern Railway maintain a transportation corridor about ½ mile from CI/BC. There appears to be no restrictions on the material carried along these rail lines.*** ***A leg of the Piedmont Petroleum Pipeline (PPP) runs underneath the office park in the vicinity of CI/BC. Part of Piedmont's regional network, this portion of the pipeline normally carries a variety of refined products, including commercial and military jet fuels, diesel and three grades of gasoline, home heating fuels, etc. Four buried pipes carry approximately 20 million gallons per day.*** ***Connected to the pipeline, less than 1 mile from CI/BC, is a 20-million gallon capacity fuel farm. Operated by the Shellexxico Company, this tank farm stores a variety of petroleum products, primarily gasoline.*** ***Two airports are in the vicinity of CI/BC. One is a major international airport approximately 8 miles away. The other is a small, but busy general aviation***

Section	Vulnerability Question	Guidance	Observations
		collection; wastewater treatment **Government services** Federal/state/local government offices – post offices, law enforcement stations, fire/rescue, town/city hall, local mayor's/governor's residences, judicial offices and courts, military installations (include type-active, Reserves, National Guard) **Emergency services** Backup facilities, communications centers, Emergency Operations Centers (EOCs), fire/Emergency Medical Service (EMS) facilities, Emergency Medical Centers (EMCs), law enforcement facilities **The following are not critical infrastructure, but have collateral damage potential to consider:** **Agricultural facilities:** chemical distribution, storage, and application sites; crop spraying services; farms and ranches; food processing, storage, and distribution facilities **Commercial/manufacturing/industrial facilities:** apartment buildings; business/corporate centers; chemical plants (especially those with Section 302 Extremely Hazardous Substances); factories; fuel production, distribution, and storage facilities; hotels and convention centers; industrial plants; raw material production, distribution, and storage facilities; research facilities and laboratories; shipping, warehousing, transfer, and logistical centers **Events and attractions:** festivals and celebrations; open-air markets; parades; rallies, demonstrations, and marches; religious services; scenic tours; theme parks **Health care system components:** family planning clinics; health	***airport approximately 2 miles away.***

Section	Vulnerability Question	Guidance	Observations
		department offices; hospitals; radiological material and medical waste transportation, storage, and disposal; research facilities and laboratories, walk-in clinics **Political or symbolically significant sites:** embassies, consulates, landmarks, monuments, political party and special interest groups offices, religious sites **Public/private institutions:** academic institutions, cultural centers, libraries, museums, research facilities and laboratories, schools **Recreation facilities**: auditoriums, casinos, concert halls and pavilions, parks, restaurants and clubs (frequented by potential target populations), sports arenas, stadiums, theaters, malls, and special interest group facilities; note congestion dates and times for shopping centers References: *FEMA 386-7, FEMA SLG 101, DOJ NCJ181200*	

Section	Vulnerability Question	Guidance	Observations
1.2	Does the terrain place the building in a depression or low area?	Depressions or low areas can trap heavy vapors, inhibit natural decontamination by prevailing winds, and reduce the effectiveness of in-place sheltering. Reference: *USAF Installation Force Protection Guide*	***Based on terrain elevation data, the ground level of the tank farm is 49 feet higher than the ground level at CI/BC. Only some of the fuel tanks are bermed, but leaking fuel is not likely to reach CI/BC's office park. The interstate highway between the two is 16 feet lower than the tank farm and slightly lower than the office park. Thus, any leak will follow the interstate and not reach CI/BC.*** ***The rear parking area behind CI/BC slopes steeply away from the building to a stream which allows winds to pass over the structure unhindered.*** ***CI/BC is not in a depression or low area.***
1.4	Is a perimeter fence or other types of barrier controls in place?	The intent is to channel pedestrian traffic onto a site with multiple buildings through known access control points. For a single building, the intent is to have a single visitor entrance. Reference: *GSA PBS-P100*	***There is no fence or other type of barrier on the site's perimeter. The only fence is a short 4-foot high fence for life safety to keep anyone from falling down the steep embankment in the rear of the building.***
1.5	What are the site access points to the site or building?	The goal is to have at least two access points – one for passenger vehicles and one for delivery trucks due to the different procedures needed for each. Having two access points also helps if one of the access points becomes unusable, then traffic can be routed through the other access point. Reference: *USAF Installation Force Protection Guide*	***There are three vehicle access points into the parking lot spread along the main road.*** ***Access to the CI/BC building includes the loading dock on the west side (rear) of the building and front entrance with an 8-foot overhang.*** ***There are three exits from the mezzanine and four exits from the building.***

Section	Vulnerability Question	Guidance	Observations
1.7	Is there vehicle and pedestrian access control at the perimeter of the site?	Vehicle and pedestrian access control and inspection should occur as far from facilities as possible (preferably at the site perimeter) with the ability to regulate the flow of people and vehicles one at a time. Control on-site parking with identification checks, security personnel, and access control systems. Reference: *FEMA 386-7*	***There is no access control to the site; however, security personnel monitor parking areas, and rear parking areas are well lit and monitored by CCTV cameras. Front parking areas are lit only.*** ***Proximity card readers prevent access to CI/BC by unauthorized personnel for normal entry, i.e. not criminal entry through forced entry means.***
1.10	What are the existing types of vehicle anti-ram devices for the site or building? Are these devices at the property boundary or at the building?	Passive barriers include bollards, walls, hardened fences (steel cable interlaced), trenches, ponds/basins, concrete planters, street furniture, plantings, trees, sculptures, and fountains. Active barriers include pop-up bollards, swing arm gates, and rotating plates and drums, etc.	***There are no vehicle anti-ram barriers installed, either at the property boundary or at the building.***
1.13	Does site circulation prevent high-speed approaches by vehicles?	The intent is to use site circulation to minimize vehicle speeds and eliminate direct approaches to structures. Reference: *GSA PBS-P100*	***No, entering at the center access point from the main road, turning left, and then turning right to proceed in front of the southern-most building, a car could easily reach 75 mph when striking the CI/BC building.*** ***The other two approaches have 90-degree turns at the end which severely hampers high-speed approach to CI/BC.***
1.14	Are there offsetting vehicle entrances from the direction of a vehicle's approach to force a reduction of speed?	Single or double 90-degree turns effectively reduce vehicle approach speed. Reference: *GSA PBS-P100*	***There are three long straightaways approaching the CI/BC building, with only one that is straight enough to achieve a high speed approach. Thus, turns on the two northernmost approaches have benefit in reducing vehicle approach speed toward the CI/BC building.*** ***Using speed bumps,***

Section	Vulnerability Question	Guidance	Observations
			especially angled speed bumps would be one way to reduce speed. Using barriers to direct traffic so there is no long straightaway is another approach. An "S" route entrance may be frustrating for visitors, but would significantly reduce the maximum speed capability of any vehicle approach to the buildings. ***As a minimum, closing off the parking slots serving the central building in the complex (the one CI/BC is in) with barriers or planters should be considered as a minimum to reduce high speed approach and increase stand-off. Similarly, the tenants of the other two buildings may want the same correction to their buildings but with a major reduction in available parking spaces.***
1.16	Does adjacent surface parking on site maintain a minimum stand-off distance?	The specific stand-off distance needed is based upon the design basis threat bomb size and the building construction. For initial screening, consider using 25 meters (82 feet) as a minimum with more distance needed for unreinforced masonry or wooden walls. Reference: *GSA PBS-P100*	***Adjacent parking is that parking associated with the next building or site that is not under the control of the owners of the building being assessed.*** ***There is no adjacent parking per se as it is one office park, but the one parking lot or area can be used by any tenant or visitor to the office park. Stand-off distance to the front parking lot is less than the 82 feet screening value. Cars or trucks can drive up to the loading dock in the rear.***

Section	Vulnerability Question	Guidance	Observations
1.19	Do site landscaping and street furniture provide hiding places?	Minimize concealment opportunities by keeping landscape plantings (hedges, shrubbery, and large plants with heavy ground cover) and street furniture (bus shelters, benches, trash receptacles, mailboxes, newspaper vending machines) away from the building to permit observation of intruders and prevent hiding of packages. If mail or express boxes are used, the size of the openings should be restricted to prohibit the insertion of packages. Reference: *GSA PBS-P100*	***There is no street furniture shown for this building.*** ***The landscaping shown is grass and trees are mature/tall enough so that a package cannot be hidden at the base. The hedge along the building drip line may conceal a package, if allowed to get taller or denser.*** ***There is no mail or express box and there is no slot in the glass main entrance door.*** ***Due to the size of the building columns, a package could be overlooked.***
1.20	Is the site lighting adequate from a security perspective in roadway access and parking areas?	Security protection can be successfully addressed through adequate lighting. The type and design of lighting, including illumination levels, is critical. Illuminating Engineering Society of North America (IESNA) guidelines can be used. The site lighting should be coordinated with the CCTV system. Reference: *GSA PBS-P100*	***Both rear and front parking areas are well lit. Rear areas are also monitored by CCTV cameras.***
1.21	Are line-of-sight perspectives from outside the secured boundary to the building and on the property along pedestrian and vehicle routes integrated with landscaping and green space?	The goal is to prevent the observation of critical assets by persons outside the secure boundary of the site. For individual buildings in an urban environment, this could mean appropriate window treatments or no windows for portions of the building. Once on the site, the concern is to ensure observation by a general workforce aware of any pedestrians and vehicles outside normal circulation routes or attempting to approach the building unobserved.	***No, lines of sight are not integrated with landscaping and green space. There are clear, approximately 300-foot, lines of sight in all directions from buildings in this office park to easily accessible locations outside the office park.***

Section	Vulnerability Question	Guidance	Observations
		Reference: *USAF Installation Force Protection Guide*	
1.23	Are all existing fire hydrants on the site accessible?	Just as vehicle access points to the site must be able to transit emergency vehicles, so too must the emergency vehicles have access to the buildings and, in the case of fire trucks, the fire hydrants. Thus, security considerations must accommodate emergency response requirements. Reference: *GSA PBS-P100*	***Yes, fire hydrants in the office park are currently accessible and the hydrant nearest to CI/BC is 200 feet away.***
2	**Architectural**		
2.2	Is it a mixed-tenant building?	Separate high-risk tenants from low-risk tenants and from publicly accessible areas. Mixed uses may be accommodated through such means as separating entryways, controlling access, and hardening shared partitions, as well as through special security operational countermeasures. Reference: *GSA PBS-P100*	***The building is a multiple-tenant facility and there are multiple buildings in the office park with multiple tenants.*** ***CI/BC has neighbors on one side in its building and a different neighbor in the adjacent building.***
2.3	Are pedestrian paths planned to concentrate activity to aid in detection?	Site planning and landscape design can provide natural surveillance by concentrating pedestrian activity, limiting entrances/exits, and eliminating concealment opportunities. Also, prevent pedestrian access to parking areas other than via established entrances. Reference: *GSA PBS-P100*	***Each tenant facility has its own entrance, spreading pedestrian activity across the front of the buildings within easy observation of each entrance to aid in detection.*** ***Loading docks are likewise spread out across the rear of the buildings. CI/BC uses a CCTV camera on the building rear to aid in detection of personnel approaching the rear entrance.***
2.4	Are there trash receptacles and mailboxes in close proximity to the building that can be used to hide explosive devices?	The size of the trash receptacles and mailbox openings should be restricted to prohibit insertion of packages. Street furniture, such as newspaper vending machines, should be kept sufficient distance (10 meters or 33 feet) from the building, or brought inside to a	***There is no indication that there are trash receptacles and mailboxes in close proximity to the building.*** ***The dumpster is approximately 50 feet from the rear of the building.***

Section	Vulnerability Question	Guidance	Observations
		secure area. References: *USAF Installation Force Protection Guide and DoD UCF 4-010-01*	
2.15	Are critical assets (people, activities, building systems and components) located close to any main entrance, vehicle circulation, parking, maintenance area, loading dock, or interior parking? Are the critical building systems and components hardened?	Critical building components include: Emergency generator, including fuel systems, day tank, fire sprinkler, and water supply; Normal fuel storage; Main switchgear; Telephone distribution and main switchgear; Fire pumps; Building control centers; Uninterruptible power supply (UPS) systems controlling critical functions; Main refrigeration and ventilation systems if critical to building operation; Elevator machinery and controls; Shafts for stairs, elevators, and utilities; Critical distribution feeders for emergency power. Evacuation and rescue require emergency systems to remain operational during a disaster and they should be located away from attack locations. Primary and backup systems should be separated to reduce the risk of both being impacted by a single incident if collocated. Utility systems should be located at least 50 feet from loading docks, front entrances, and parking areas. One way to harden critical building systems and components is to enclose them within hardened walls, floors, and ceilings. Do not place them near high-risk areas where they can receive collateral damage. Reference: *GSA PBS-100*	***This building is not large enough to maintain separation distances.*** ***Attack from the front of the building would primarily impact the Business Center and office space. Attack from the rear would affect critical utilities and, through the loading dock area, the heart of the company – the computer center.*** ***No critical components are hardened as seen by the natural gas and electric service to the building.*** ***The UPS, mechanical and electrical room, and the diesel generator could be affected by a single bomb less than 50 feet from all these areas or taken out by a single wayward truck.***
2.16	Are high value or critical assets located as far into the interior of the building as possible and separated from the public areas of the building?	Critical assets, such as people and activities, are more vulnerable to hazards when on an exterior building wall or adjacent to uncontrolled public areas inside the building. Reference: *GSA PBS-100*	***People are located along the exterior wall at the front of the building.*** ***The Information Division secure space and the Business Center secure offices have the best***

Section	Vulnerability Question	Guidance	Observations
			interior space location – not on an exterior wall, as does the main conference room. ***The Business Center is separated from the Information Division by a single wall, with secure spaces properly protected.*** ***Even though the Business Center is open to the public, access of the public comes under some controls within the building envelope.***
5	**Utility Systems**		
5.1	What is the source of domestic water? (utility, municipal, wells, lake, river, storage tank) Is there a secure alternate drinking water supply?	Domestic water is critical for continued building operation. Although bottled water can satisfy requirements for drinking water and minimal sanitation, domestic water meets many other needs – flushing toilets, building heating and cooling system operation, cooling of emergency generators, humidification, etc. Reference: *FEMA 386-7*	***The water to the fire protection system within the building and the fire hydrants in the office park comes from the local municipal distribution mains which is also the source for all water uses in the building – rest rooms, kitchen/break room, HVAC equipment, etc. There is only one water supply line to the CI/BC building.*** ***Per request from employees, four bottled water dispensers are throughout the building, with an average of 2 water bottles (5 gallons each) in reserve at any given time for each dispenser.***
5.4	Does the building or site have storage capacity for domestic water? How many gallons of storage capacity are available and how long will it allow operations to continue?	Operational facilities will require reliance on adequate domestic water supply. Storage capacity can meet short-term needs and use water trucks to replenish for extended outages. Reference: *Physical Security Assessment for Department of Veterans Affairs Facilities*.	***The building currently stores drinking water as delivered in 5-gallon bottles. The site has the capacity to have 80 gallons on hand at the time of delivery. The bottled water supply would last for a few days to one week for drinking purposes only.*** ***There are no storage tanks for servicing other water***

Section	Vulnerability Question	Guidance	Observations
			uses in the CI/BC building.
5.5	What is the source of water for the fire suppression system? (local utility company lines, storage tanks with utility company backup, lake, or river) Are there alternate water supplies for fire suppression?	The fire suppression system water may be supplied from the domestic water or it may have a separate source, separate storage, or nonpotable alternate sources. For a site with multiple buildings, the concern is that the supply should be adequate to fight the worst case situation according to the fire codes. Recent major construction may change that requirement. Reference: *FEMA 386-7*	***The only water source for fire suppression is the municipal water mains serving the office park.***
5.10	What fuel supplies do the building rely upon for critical operation?	Typically, natural gas, propane, or fuel oil is required for continued operation. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***Heating for the CI/BC building is provided by a combination of natural gas and electricity.*** ***The backup electric generator uses diesel fuel.***
5.11	How much fuel is stored on the site or at the building and how long can this quantity support critical operations? How is it stored? How is it secured?	Fuel storage protection is essential for continued operation. Main fuel storage should be located away from loading docks, entrances, and parking. Access should be restricted and protected (e.g., locks on caps and seals). References: *GSA PBS-P100 and Physical Security Assessment for the Department of Veterans Affairs Facilities*	***Emergency power is provided by a single diesel generator, located in a shed in the rear parking lot. The generator has a 50-gallon day tank, maintained at 80 percent capacity. A 2,000-gallon main tank is buried under the parking lot, near the generator.*** ***There are no security measures for the fuel.***
5.12	Where is the fuel supply obtained? How is it delivered?	The supply of fuel is dependent on the reliability of the supplier. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***Natural gas enters the building through two meters under the loading dock staircase and is supplied from the local gas distribution company.*** ***Diesel fuel is delivered by truck from a local supplier, who normally responds the day after being called.***

Section	Vulnerability Question	Guidance	Observations
5.14	What is the normal source of electrical service for the site or building?	Utilities are the general source unless co-generation or a private energy provider is available. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***Electric power for CI/BC is provided by Hazardville Electric Company through two transformers outside the building. Two sets of buried transmission lines deliver 12,470 volt (12.47KV) power to the two separate transformers outside the building from a nearby substation.***
5.15	Is there a redundant electrical service source? Can the site or buildings be fed from more than one utility substation?	The utility may have only one source of power from a single substation. There may be only single feeders from the main substation. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***Each transformer with its respective feeder can handle the complete electrical load of CI/BC.*** ***However, both feeders come from the same substation.***
5.18	What provisions for emergency power exist? What systems receive emergency power and have capacity requirements been tested? Is the emergency power collocated with the commercial electric service? Is there an exterior connection for emergency power?	Besides installed generators to supply emergency power, portable generators or rental generators available under emergency contract can be quickly connected to a building with an exterior quick disconnect already installed. Testing under actual loading and operational conditions ensures the critical systems requiring emergency power receive it with a high assurance of reliability. Reference: *GSA PBS-P100*	***Emergency power is provided by a single diesel generator with a maximum capacity of 1250 KW/1562.5 KVA. This generator is large enough to take the complete load of the building.*** ***The backup diesel generator has never had to support CI/BC's power demands for longer than about 2 hours, and never with more than one chiller operating. It has never been tested for an extended period under a heavy load. The diesel generator is configured to automatically start upon loss of commercial power to the Computer Center Bus (CCB). This happens about twice a year due to electrical storms or utility maintenance in the neighborhood.*** ***Batteries to support the UPS were tested 2 years ago and calculated to provide 60***

Section	Vulnerability Question	Guidance	Observations
			minutes of power for orderly shutdown of the Computer Center. ***Using 0.08 gallons per hour per KW (a DoD design minimum) the generator with a 250 gallon day tank (80% full) and a 2,000 gallon storage tank will carry the maximum load for 22 hours, which would require daily refilling for an extended outage.*** ***The generator is outside the CI/BC building, but the Automatic Transfer Switch and commercial power service entrances are collocated in the Mechanical and Electrical Room.*** ***There is no exterior connection for electric power (like a fire pumper Siamese connection). A backup generator to the backup would either have to be wired to the Automatic Transfer Switch or spliced into the cables leaving the installed generator.***

Section	Vulnerability Question	Guidance	Observations
5.19	By what means do the main telephone and data communications interface the site or building?	Typically communication ducts or other conduits are available. Overhead service is more identifiable and vulnerable. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***CI/BC has two T1 lines and one T3 line connected at the demark to ATT's high performance backbone network. The ATT fiber connectivity provides more than enough bandwidth for CI/BC's current needs and planned future expansion.*** ***The demark is in the Comm Center on the opposite side of the building from the Mechanical and Electrical Room.*** ***As with all other utilities, the telephone and data service is underground.***
5.21	Does the fire alarm system require communication with external sources? By what method is the alarm signal sent to the responding agency: telephone, radio, etc.? Is there an intermediary alarm monitoring center?	Typically, the local fire department responds to an alarm that sounds at the station or is transmitted over phone lines by an auto dialer. An intermediary control center for fire, security, and/or building system alarms may receive the initial notification at an on-site or off-site location. This center may then determine the necessary response and inform the responding agency. Reference: *Physical Security Assessment for the Department of Veterans Affairs Facilities*	***The Security Officer has a key to the building that has the main fire panel. The main fire panel is located in the lobby area, which is open to unrestricted access during normal business hours. In the event of a fire, the panel alerts the local fire department and the security company using dedicated telephone lines.*** ***There is no intermediary alarm monitoring center, but the security company acts as a backup to ensure the fire department is alerted.***

Site and Layout Design Mitigation Measures
(COOP Version)

NOTE: There is too much variance in student answers compared to a "school solution" to populate this table with information that can be compared to the various team answers.

Asset-Threat/Hazard Pair	Current Risk Rating	Suggested Mitigation Measure	Revised Risk Rating

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