

**CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)
AND THE ROLE OF FACILITIES PLANNING IN FORCE PROTECTION**

By

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**Abstract of Final Project Presented to the Graduate School
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Master in Arts in Urban and Regional Planning**

**CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED) AND
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By

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Chairman: Dr. Richard Schneider

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This report examines the current role of facilities planning in force protection. It concentrates on a specific planning technique, Defensible Space, also called Crime Prevention Through Environmental Design (CPTED), as a method that planners and facilities personnel can use to contribute to the force protection of a facility (Jefferey, 1977, Crowe, 1991). The following four areas are included:

1. An examination of CPTED, it's potential use in Force Protection, and the development of guidelines for it's future use.
2. An examination of significant acts of terrorism to see if and how CPTED guidelines could have been applied to increase target security.
3. Examples of how CPTED guidelines were applied to improve Force Protection at Joint Interagency Task Force - East (JIATF-EAST).
4. A review of current Navy policy on Force Protection and the role of planning in that policy.

The principles of CPTED are examined in detail. The historical background for CPTED, and security in general, are examined in order to help explain how these concepts were developed. Modern security theory and techniques are reviewed in order to emphasize the difference between these theories and the CPTED principles. The psychological aspects of CPTED theory are also examined in order to help explain the principles.

This section includes a discussion about terrorism and how it differs from the Navy definition of force protection and from other crimes. Significant acts of terrorism are examined in order to project if and how the CPTED guidelines could have been applied to increase target security. The following incidents are discussed:

- U.S. Marine barracks, Beirut, Lebanon
- Khobar Towers, Dhahran Air Base, Saudi Arabia
- Federal Building, Oklahoma City
- U.S. Embassies in Nairobi and Dar es Salaam.

Although only the first two targets were on military installations, the other two examples are valuable because they illustrate recent patterns of terrorist attacks at U.S. and foreign facilities.

A set of guidelines for the future use of CPTED in Force Protection are developed based on the planning model. The JIATF-EAST project is used as an example of how to implement the developed CPTED guidelines. An in depth discussion of the project includes: (1) the process that was used to develop the design; (2) an overview of the existing facility; (3) existing opportunities and constraints and (4) the design solutions and their CPTED basis.

The review of current Navy policy provides a baseline that shows the present role of facilities planning in force protection. Basic security policy is also briefly examined. The principles and techniques of CPTED discussed earlier are then compared to the current Navy Policy on Force Protection. Based on this comparison a general set of recommendations are developed which can be used by planners and facility personnel to increase force protection through the use of CPTED.

CHAPTER ONE INTRODUCTION

Report Impetus – JIATFE Project

This report was inspired by a project that was conducted in the fall 1997 Defensible Space Course at the University of Florida. This project was undertaken for the Joint Interagency Task Force - East (JIATF-EAST). Located on Truman Annex at Naval Air Station Key West, FL, JIATF-EAST is a U.S. government agency with the mission to detect and monitor aerial and maritime drug trafficking in the Atlantic, Caribbean and Eastern Pacific transit zones. The base security personnel are concerned about the potential of truck and car bomb attacks and the lack of standoff distance around their four-building complex.

Due to an open base policy at Truman Annex and the inclusion of recreational activities at the facility, the base personnel were interested in a design that would be more aesthetically pleasing than traditional security methods. The security officer contacted the University and proposed that the architecture college do a plan for the base. Due to the security aspects of the plan, the project was given to the Defensible Space class, with the support and assistance of an undergraduate Landscape Architecture Studio.

The objective of the JIATF-East project was to devise a plan that would increase force protection on the base and at the JIATF-East facility through the use of CPTED

principles and techniques. Given the base's desire for an aesthetically pleasing design, the CPTED concepts seemed an ideal solution for the project.

The Role of Planning in Force Protection

The JIATF-East project illustrates that force protection is a priority in DOD that planners will have to take into consideration when they are designing or upgrading facilities. Facilities planning can play a major role in force protection now and in the future. Planning allows for the incorporation of protection strategies at the *beginning* of the design process. Through proper planning, costly retrofitting can be avoided because activity placement and natural design techniques can be used to achieve the same purposes that only expensive technical equipment can achieve in some existing situations.

Planners and facility personnel are in a position to be able to develop a comprehensive physical plan for an entire facility. A comprehensive plan is inherently more effective than one that is done randomly in small pieces. Planners also have the training to be able to look at and understand the role of the facility in context with adjacent areas. This is valuable due to the increasing importance of the interface between bases and their surrounding communities (Alexander, 1986).

CPTED Overview

The planning and security communities have been using CPTED for a number of years to help reduce more common crimes in business and housing areas through the effective use and design of the built environment. Only recently have the concepts been applied to the crime of terrorism. These "environmental approaches" to crime prevention

were made popular by Oscar Newman in his book "Defensible Space" (Newman, 1972) and then later elaborated upon by other researchers such as Taylor, Crowe, Clarke, and P. Von Brintinghorn. CPTED includes several basic principles that can have different titles depending on the source used. In general they consist of:

1. Territoriality – suggests that physical design can contribute to a sense of control and proprietorship in users (Newman, 1972).
2. Surveillance – "eyes on the street," the goal of which is to keep intruders under observation (Newman, 1972).
3. Access control – has a goal of decreasing crime opportunity by denying access or making it more difficult and creating the perception of risk (Crowe, 1991).
4. Activity Placement – involves design of physical space in the context of the needs of the space's users, the designated normal use of the space, and the predicted behavior of both users and offenders (Crowe, 1991).
5. Maintenance – encourages the upkeep and continual re-evaluation of the systems. This principle is also concerned with the image and milieu of the area, which are intended to combat the "broken window" effect (Newman, 1972, Wilson and Kelling, 1982).

These concepts are discussed in greater detail in Chapter 2. CPTED concentrates on using the natural environment to manipulate behavior instead of relying on electrical or mechanical devices, or additional human resources, although these latter methods are not ruled out. The CPTED emphasis on design and use differs from the traditional target hardening approach that focuses on denying access to target through mechanical and

electrical devices and other physical or artificial barriers (locks, alarms, fences, gates). Traditional target hardening can lead to constraints on use, access and enjoyment of the site, and it overlooks natural access control and surveillance. CPTED uses traditional target hardening methods only when they do not unduly impair use (Crowe, 1991).

Justification of Project

CPTED concepts are easy design tools for a planner or facilities person to use. CPTED concepts can also meet some external goals that traditional security methods do not. There are a variety of reasons personnel may be hesitant about implementing traditional methods of security at their facilities. Reasons for not using traditional methods may include aesthetics, psychological effects, political sensitivity, or simply, high costs.

Image

Aesthetics is one area in which CPTED concepts can be more useful than traditional security techniques. The appearance of a base or facility is a reflection of the commanding officer (CO) in charge of, and the people working on, the base. Pure functionality is no longer the only concern, the appearance of bases and facilities has become increasingly important. Landscaping on bases is increasingly prevalent. Many CO's come from ships and so the term "ship-shape" has significant meaning for them.

CO's expect the bases under their command to have a neat and orderly appearance and to reflect positively on themselves and on the Navy in general. For example, on the Norfolk Naval Base, construction sites on main thoroughfares cannot be

surrounded by chain link fences. The base commander requires high wood fencing, similar to that used in residential backyards, in order to thoroughly hide the sites. Trash on the base is also strictly controlled, with teams of sailors patrolling the base at regular intervals to make sure everything is clean. New, more architecturally interesting buildings are slowly replacing older, nondescript structures. Also, an effort is made to regularly paint older buildings to avoid the appearance that they are run down. Indeed, this same emphasis on aesthetics was a factor driving the JIATF-EAST design and planning efforts, as will be discussed in Chapter 5.

Quality of Life

Another way in which CPTED can be an improvement over traditional security is in the Quality of Life (QOL) of military and civilian personnel in the Navy, which has been of increasing emphasis in recent years. As the U.S. economy improves, the military has found it must compete for qualified and competent personnel. The dissatisfaction of personnel in the past over living conditions on the bases has lead to improved standards in housing, recreation and facilities in general. Recently, new modular office furniture has been replacing furniture that has been used for decades in most offices. There is now a general concern for the morale and welfare of military and government workers and their families.

Overuse of fences, barriers, walls, gates, and cameras, popular in traditional security configurations, can make personnel feel as though they are working in a prison like environment, with little privacy or freedom. More recent QOL philosophy tends to discourage this type of setting. CPTED uses natural elements such as landscaping and

activity placement instead of fences and cameras to increase security. The use of these CPTED principles can do much to improve the working atmosphere of personnel on Naval facilities.

Open Base Policy

Another recent Navy phenomenon is the Open Base Policy on many of the bases around the country, including Truman Annex, in Key West, the site of the JIATF-EAST facility. This policy was introduced because of cutbacks in both military manpower and budget areas, and to encourage more open relationships with the areas outside the facilities. However, this policy has increased concerns regarding both security and the interface between the Navy and the surrounding civilian community.

There has been a push in recent years for Navy facilities to promote positive relationships with the surrounding communities. Most bases now have Public Relations Offices and officers whose job it is to help military facilities interface positively with the public. Because the appearances of the bases are a reflection of the Navy as a whole, it will be increasingly important to create a friendly image in order to maintain a good relationship with neighboring communities. Timothy Crowe, in his book on CPTED, warns how the overuse of technology as a means of security can create a "fortress effect" that destroys the surrounding land uses and create a "no-man's" land (Crowe, 1991). By using a more natural approach, CPTED techniques can maintain security while reducing its visual impact.

CHAPTER TWO

CPTED

Overview

This section will examine actual CPTED and defensible space principles and techniques. As a precursor to this, the historical background of defense and security will be reviewed, as will the historical roots of environmental psychology. Modern environmental psychology will be discussed as it relates to CPTED. Modern security theory and techniques will also be discussed, emphasizing its differences from CPTED strategies.

Background

The concepts behind CPTED are not new. They are based on some of the basic strategies about defense and physical defense systems that date back to the times of the first villages in Neolithic times (Mumford, 1960). The concept of defense is one of the oldest reasons for subsequent town and city development (Kostof, 1992). The use of design and space management to manipulate human behavior is over 5000 years old (Crowe, 1991). CPTED follows many of these ancient concepts of defense and of "environmental psychology".

Historical Examples of Defense and Environmental Psychology

In the times before advanced technology, man relied on physical defense methods to defend his cities. Throughout ancient times and into the Middle Ages, defense and economics were interrelated relative to the development of cities. The first villages were formed for protection and for the storage of food surplus. Even in the first primitive

villages, the notion of the *edge* and the *boundary* was important to denote where the village began and ended. Early settlements used defensive siting, such as locating on the top of a hill or next to a river, and manmade barriers, such as earthen berms, as their methods of defense. Symbolic boundaries were made tangible through the building of walls, such as those around the village in Figure 2.1. As a civilization became more advanced, its defensive barriers became more complex.

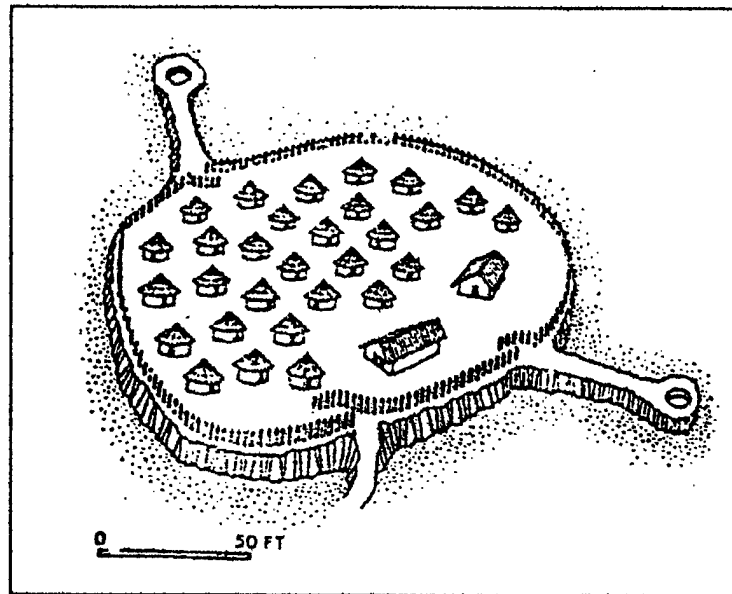


Figure 2.1: Depiction of an ancient walled village.
Source: Webber, Comprehensive Planning.

Medieval walled cities, such as the one in Figure 2.2, were good examples of the use of barrier systems to deter or delay an enemy. The curving streets in medieval cities were also designed for defense. In medieval city design, the center of the walled ring was the most important portion of the city often housing the lord or the church or both, and it was to be protected by layers of impediments and barriers. The wall was one of these layers and the streets were a second one. Some cities had several layers of walls. This layering of defenses is also an important concept in modern security.

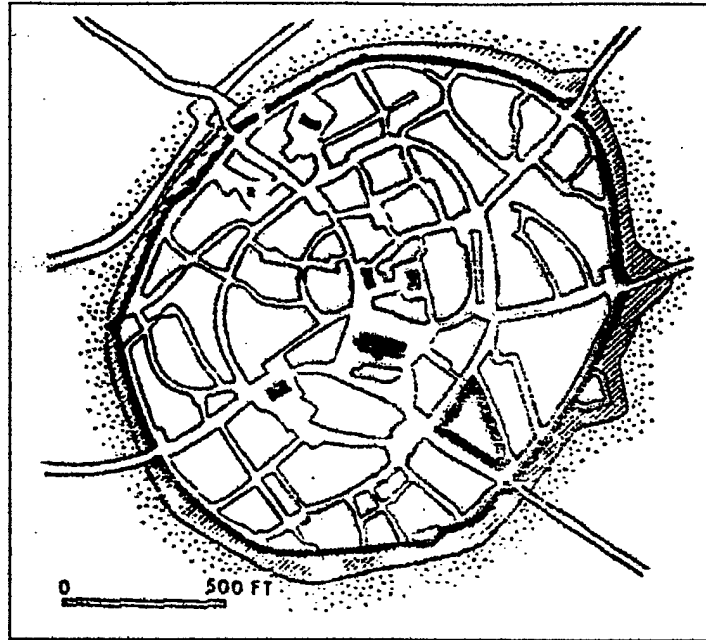


Figure 2.2: Depiction of a medieval walled city.
Source: Webber, Comprehensive Planning.

In many ancient cities the center was not only the area that was the most protected, it was also the symbolic center of the city. It represented the seat of power or the seat of religion (or both) and the closer an area was to it the more important that area was. This hierarchy of importance around the central location of palaces, temples, and churches is a very basic example of environmental psychology. Height was also used in many of these cities to indicate importance and position. A more complex example of the use of environmental psychology is from the ancient Greeks in Sicily, who would design their temples to convey an absence of light in order to produce fear in the local population (Crowe, 1991).

Other examples of psychological design methods are included in Chinese and Indian tradition of city design, in which the city form had great religious significance and represented a model of the universe, the gods, and man's relationship to them. These ancient cultures influenced and controlled their population through their myths and

beliefs and the form of their cities reinforced these aspects of their society. Many Chinese and Asian cities were laid out as a series of boxes that were divided and subdivided to represent the hierarchy of power in their societies. In the Chinese example, shown in Figure 2.3, the separation of religious and public functions may have foreshadowed the modern concept of zoning. Figure 2.4 illustrates the layered approach through multiple gates and courtyards leading to the imperial audience hall in Peking (Lynch, 1981).

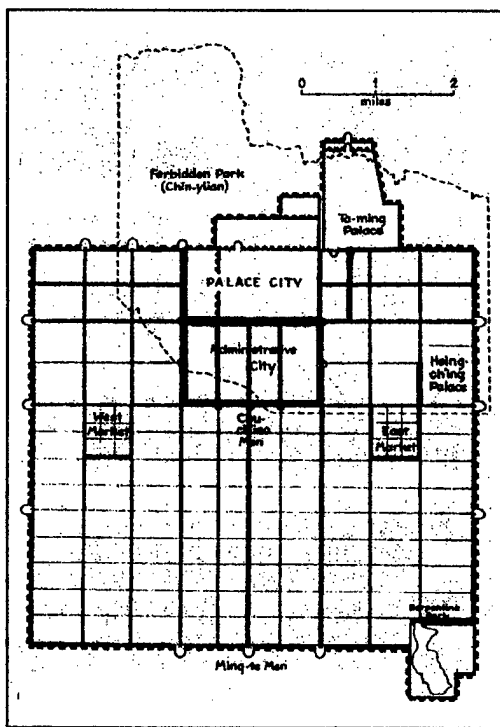


Figure 2.3: Plan of Chang'an in China.
Source: A Theory of Good City Form,
Kevin Lynch, 1981.

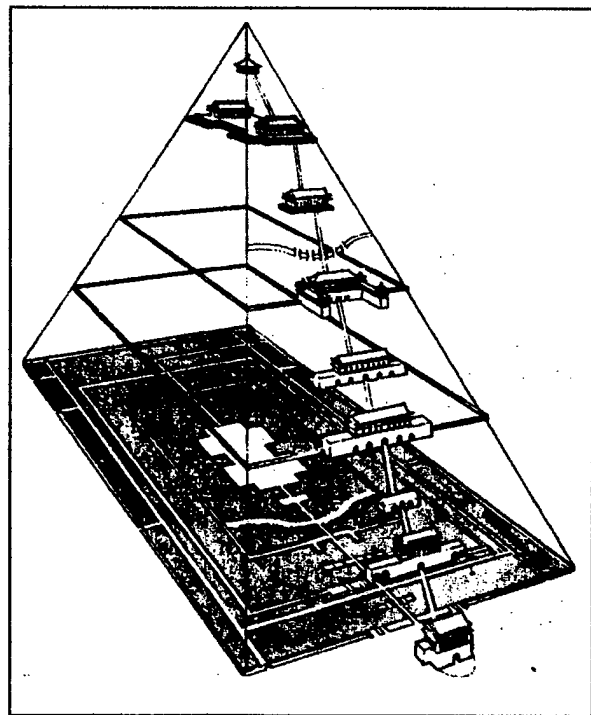


Figure 2.4: Approach to the Imperial Audience Hall in Peking.
Source: A Theory of Good City Form,
Kevin Lynch, 1981.

In India it was the tradition that to enclose and control the evil forces of chaos, the cities were designed in the form of a mandala (see Figure 2.5), which was a set of enclosing rings divided into squares. The center point of the city was considered the

most powerful and hence was to be protected from casual or non-invited incursion.

Madurai, India (Figure 2.6), is a good example of this type of city design (Lynch, 1981).

The Indian mandala is a historic example of environmental psychology.

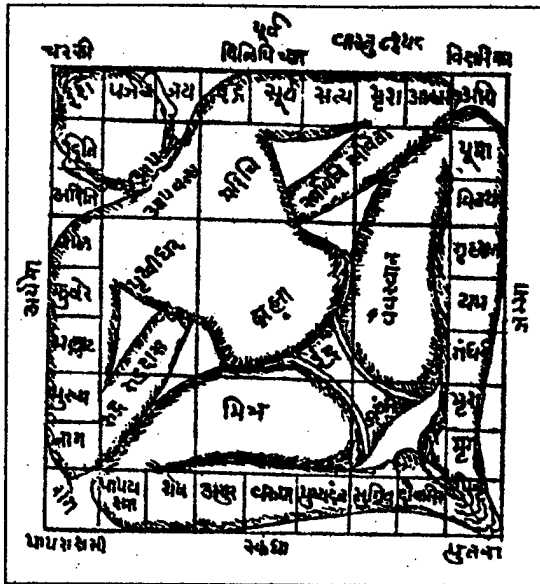


Figure 2.5: Indian mandala.
Source: A Theory of Good City Form,
Kevin Lynch, 1981.



Figure 2.6: Madurai, India.
Source: A Theory of Good City Form,
Kevin Lynch, 1981.

Modern Techniques of Security

Although many modern security techniques are very different from historical methods, many of the underlying philosophies are the same. The goal of security is detection, delay and response (NAVFAC, 1991). Therefore, physical security should attempt to make access to a target so difficult that an intruder will hesitate to choose it as his goal. And, if the intruder does attempt to pursue his target, he should be able to be easily detected and apprehended (Schultz, 1978.)

To limit access to a target, modern security theory stresses a layered approach, as illustrated in Figure 2.7. Its similarities to the design of the ancient Chinese and Indian cities is obvious. The more layers of physical security around a target, the harder it will

be to reach. Making a target more difficult to reach should decrease the likelihood that it will be pursued as a target. Detection is achieved through surveillance and good visibility. Detection increased the probability of apprehension.

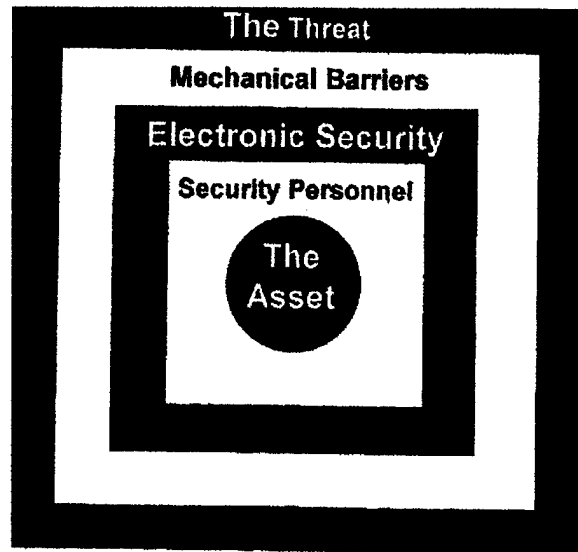


Figure 2.7: Layered Approach to Modern Security.
Source: ASIS PS Committee Workshop, 1997.

Physical security is an element of crime prevention. The National Crime Prevention institute defines crime prevention as “the anticipation, recognition and appraisal of a crime risk and the initiation of some action to remove or reduce it (the risk)” (Crowe, 1991, pg. 23). Modern security theory does recognize that perfect or absolute security can never be fully attained. “There is no object so well protected that it cannot be stolen, damaged, destroyed, or observed by unauthorized eyes” (Schultz, 1978, pg. 1).

Crowe, in his book Crime Prevention Through Environmental Design, suggests that there are three types of security strategies:

- **Organized:** labor intensive security for which cost is external to normal functions and requirements of the space.
- **Mechanical:** capital or hardware intensive security where the cost is external to the normal functions and requirements of the space.
- **Natural:** the integration of security and behavior concepts into the utilization of human and physical resources (spatial definition, placement of work stations, location of windows.)

CPTED, like other modern security techniques, uses the layered approach to security as a basic concept. One of the main differences between CPTED and other security techniques is that, while CPTED does use organized and mechanical strategies where appropriate, it is mainly based on natural security strategies. Because of this, CPTED techniques tend to be less expensive and more sustainable in the long run than the more traditional methods of security which have their emphasis on organized and mechanical security strategies.

Security design recognizes that there are three sets of users for any space or facility, they are:

- **normal users:** persons who are supposed to be in a space
- **abnormal users:** persons who are not supposed to be in a space
- **observers:** person who have to be in a space to support the human function (Crowe, 1991)

The objective of designing for security is to design a space that will facilitate the normal users, discourage the abnormal users, and still be accessible for its intended -- designed -- use.

CPTED Techniques

CPTED is a security concept that has been used for years by police departments around the nation. It is an important part of the National Institute of Law Enforcement and Criminal Justice Program's strategy in support of their goal to reduce crime and the fear of crime and to improve the general quality of life (QOL) for the citizens it protects. CPTED concepts have been successfully demonstrated in schools, commercial, residential and transportation areas (Sherman, 1997).

Modern Environmental Psychology and CPTED Theory

CPTED is based in part on concepts of environmental psychology. The theory behind environmental psychology is that there is a direct relationship between the environment and human behavior. The CPTED concept "expands upon the assumption that the proper design and effective use of the built environment can lead to a reduction in the fear of crime and the incidence of crime, and to an improvement in the quality of life." (Crowe, 1991, pg. 1). CPTED seeks to prevent certain specified crimes within a specifically defined environment by manipulating variables that are closely related to the environment itself (Crowe, 1991).

Natural Security Strategies

One of the major benefits of CPTED is that it is less expensive to design crime prevention into the way things are done than to order extra police, to order extra equipment, or to retrofit structures. While the traditional emphasis of crime prevention has been on mechanical and organized crime prevention techniques, CPTED seeks to

reduce the propensity of the physical environment to support criminal behavior. This “natural” approach to crime prevention seeks to create access control and surveillance through adapting the normal and routine uses of the environment (Crowe, 1991).

To promote the natural approach to crime prevention, CPTED incorporates three fundamental overlapping strategies into space design and management.

- *Territorial reinforcement* – Which includes natural surveillance and access control, and emphasizes the enhancement of ownership and proprietary behaviors. (Crowe, 1991).
- *Natural surveillance* – For example, a strategically placed window or the placement of an employee work station which will oversee a sensitive area or activity.
- *Natural access control* – For example, space should be designed so that people immediately understand where they are allowed and are not allowed.

These strategies are the basis of the first three of the five main principles of CPTED (*Territoriality, Surveillance and Access Control*) discussed in detail below. The basic concept of naturalness is used in the development of the other two principles: *Activity Placement and Maintenance*. Naturalness is “simply doing things you already have to do, but doing them a little better” (Crowe, 1991 pg. 34). It is important to note that although CPTED does emphasize using a natural approach where possible, mechanical and organization approaches are also encouraged when they are appropriate.

The Five Main Principles

As noted in Chapter 1, the introduction to the paper, there are five traditional CPTED principles used in the design of defensible space. They include territoriality, surveillance, access control, activity placement, and maintenance. While these principles sometimes go by different names, the underlying concepts are usually the same.

1. **Territoriality** – is the use of physical design to create a sense of user ownership. Territoriality suggests that physical design can contribute to a sense of personal control or proprietorship in users (Crowe, 1991). People usually take more interest in something they own. Designing an environment that clearly delineates private or personal space creates this sense of ownership. The appearance of ownership fosters behavior that discourages unauthorized acts within a space. Owners have a vested interest and are more likely to notice and challenge intruders (City of Tucson, 1989). Natural access control and natural surveillance contribute to a sense of territoriality (Crowe, 1991).

Territoriality is based on the ideas of *territorial definition* and *personal ownership*. Territorial definition is basically linking territory to a specific owner, or owners. It can be achieved in a number of ways including:

- Signage (Crowe, 1991).
- Changes in pavement or floor type and texture (Newman, 1972).
- The use of symbolic boundaries such as fences, hedges, and other barriers that delineate a border (Newman, 1972).

- Provision of clearly marked transition zones between public and private space (Newman, 1972).

Personal ownership can be achieved through activity placement and a number of other methods. One of the important theories of territoriality is that the fewer people who control an area the more likely they are to develop a sense of ownership for the area (Newman, 1972). Other examples include:

- Scheduling of events, such as sports and recreation, to get people to use the site regularly.
- Designing an environment that clearly delineates private or personal space and creating a hierarchy of spaces based on the movement from public to private domains.
- Using reserving parking places (Crowe, 1991).

2. **Surveillance** – means that the site can be naturally and easily observed. The goal of surveillance is to keep intruders under observation (Crowe, 1991). An example of a *natural* surveillance strategy would be the proper use and placement of windows as contrasted with the use of police patrols (organized strategy) or lighting and CCTV (mechanical strategy), although these other strategies, particularly lighting, are recommended when natural surveillance is not feasible.

Natural surveillance seeks to create an environment where accessible areas are easily visible and where there is plenty of opportunity for people engaged in their normal activities to see and observe the spaces around them (City of Tucson, 1989). Mechanical

and organizational approaches should also be considered when appropriate. Figure 2.8 illustrates the differences between a space designed for good natural surveillance and a space that did not take natural surveillance into account.



Figure 2.8: Surveillance: The subway in Washington D.C. is open and encourages natural surveillance (left), unlike the subway in New York City (right).
Source: ENR, 1995.

Activity placement is one of the primary ways to accomplish natural surveillance. For example, placing desks so that they face windows or office entrances encourages the viewing of people entering the area or the site. When designing buildings, windows are preferred over blank walls in order to provide “eyes on the street” and to avoid the “fortressing” effect, which is illustrated in Figure 2.9 (Post, 1995).

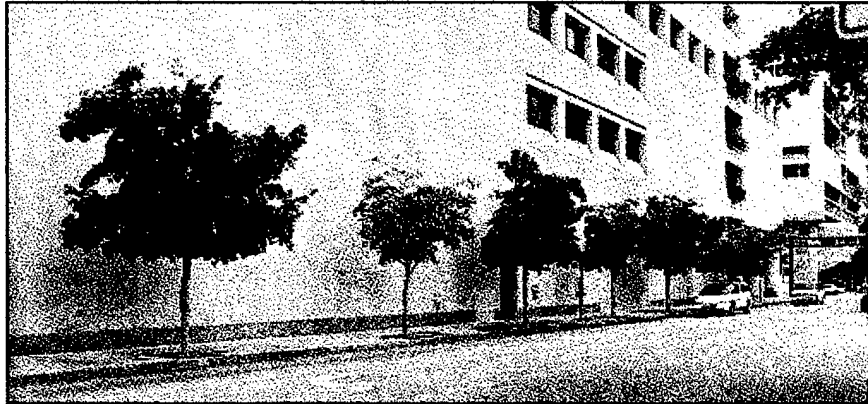


Figure 2.9: Fortressing.
Source: ENR 1995.

Other ways to increase natural surveillance include:

- Relocating gathering areas to encourage a view of the site.
- Making sure that visibility is not physically impaired by obstacles such as high brush and unnecessary walls.
- Providing appropriate lighting locations and levels.

3. **Access control** – is where access is limited to official users of the activity by making non-user presence exceptional or out of the ordinary. Access control has a goal of decreasing crime opportunity by denying access and creating the perception of risk (Crowe, 1991). Traditional examples of access control are based on the three types of security techniques including:

- organized (guards)
- mechanical (locks)
- natural (spatial definitions)

Natural access control can include layers of non-mechanical/electrical barrier systems. It can also include slowing down the approach to a target by means of traffic calming or other techniques.

One of the main methods of achieving natural access control is through the use of barriers, both physical and psychological. Note that it is also important to balance access control with surveillance considerations, for example selecting a type of landscaping that can act as a barrier, but not impede vision (it is recommended that wall and hedge heights not exceed 2.5 feet (Post, 1995)). There are many types of barriers available. Natural barriers can include landscaping elements such as rocks, trees, low walls or planters, terraced landscaping (Figure 2.10 illustrates a terraced courtyard in front of an office building), site amenities such as fountains, statues, or flag poles, removable bollards, and fences.

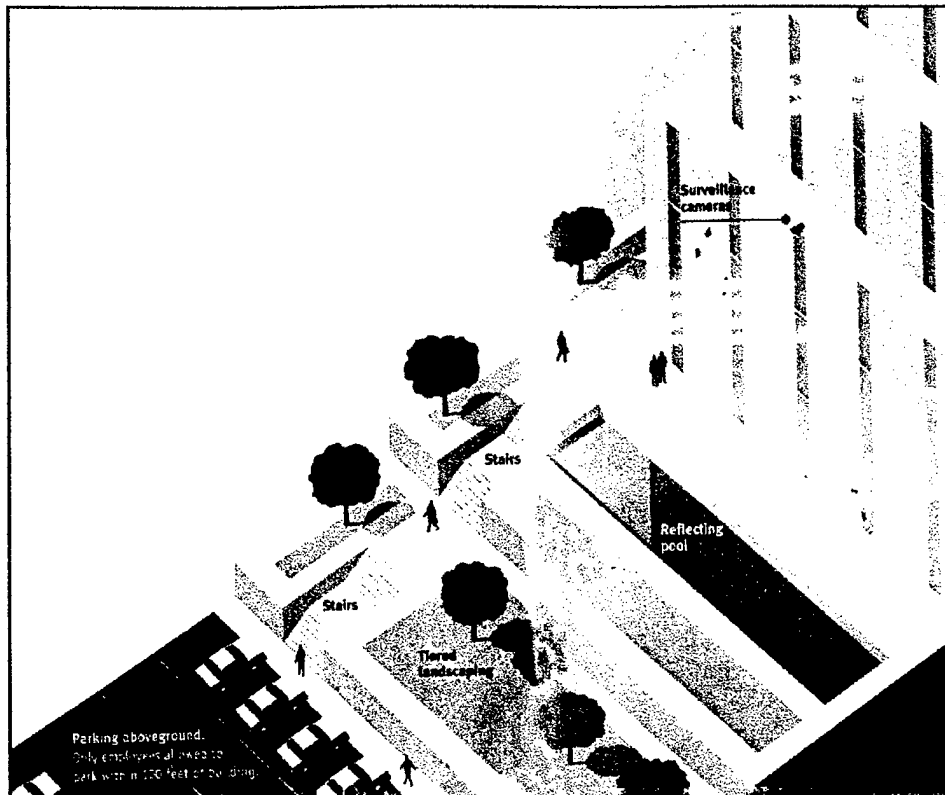


Figure 2.10: Terraced Office Courtyard.
Source: Popular Science, 1996.

It is important to note that barriers should be effective physically. For example, as illustrated in Figure 2.11, a chain link fence may be an effective psychological barrier, but it may not be as effective physically as other fence types or barriers.

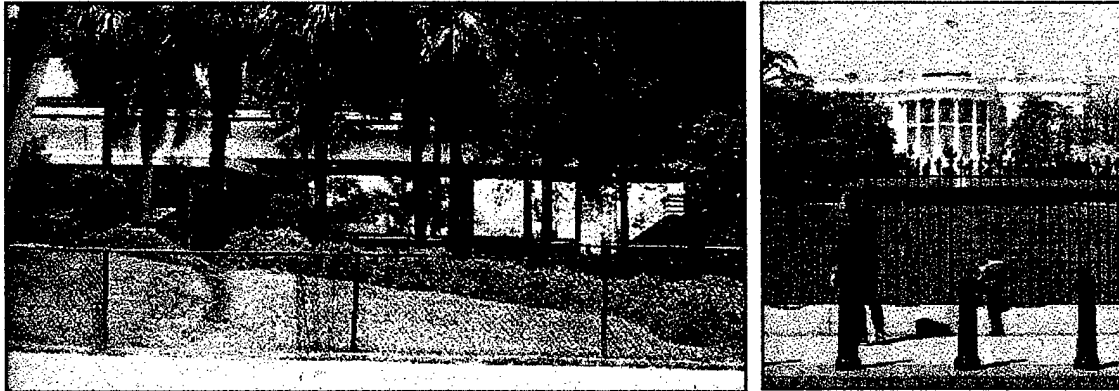


Figure 2.11: Effective Barriers: chain link fence (left) can be easily cut or climbed. Iron or steel fencing (right) is sturdier and has no crosspieces for climbing.

Source: ENR, 1995.

Other examples of natural access control include:

- Considering all vehicular approaches, in other words, just because the road doesn't go to the building doesn't mean the car can't get there.
- Creating specific "zones" of activity – such as keeping visitors parking separate from employee parking.
- Including traffic calming strategies such as curving roads, adding central medians, adding road humps and speed bumps, and making the roads narrower. Other methods to reduce traffic speed include, planting trees close to the edge of the road to make the road feel narrower, and putting stripes on the road at decreasing intervals to make drivers feel like they are going faster. Figure 2.12 illustrates the use of parking as a traffic calming strategy. This strategy also encourages pedestrians to use the sidewalk, which increases natural surveillance and territoriality.

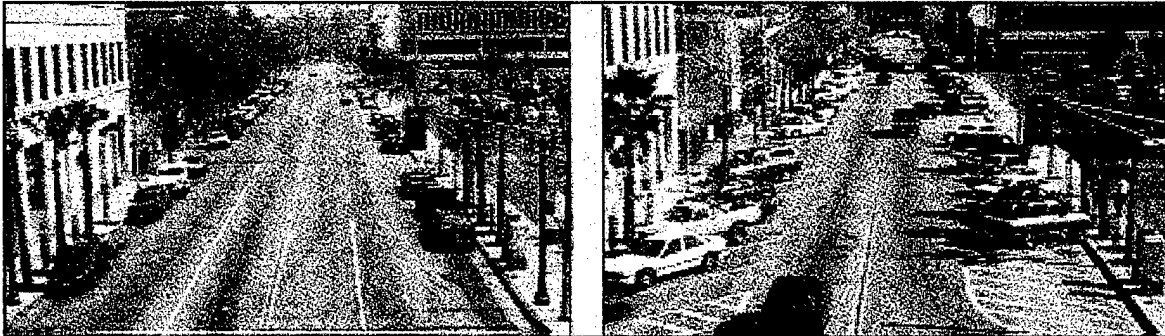


Figure 2.12: Traffic Calming: angled parking (right) is one device that can be used for traffic calming.

Source: ENR, 1995

4. **Activity Placement** – is the logical placement of user activities to encourage the above principles. Crime prevention should flow naturally and routinely from the activity being promoted in a space. CPTED involves the design of physical space in the context of the needs of the space’s users, the designated normal use of the space, and the predicted behavior of both users and offenders (Crowe, 1991). Design approaches include:

- Recognizing the designated use of a space.
- Defining the problems and compatible solutions.
- Incorporating strategies that enhance (or do not impair) the effective use of the space.

Crowe uses the “Three-D” approach, which is based on three functions or dimensions of human space, as a guide to determine the appropriateness of how space is designed and used:

- “All human space has some *designated* purpose.

- All human space has some social, cultural, legal or physical *definitions* that proscribe the desired and acceptable behaviors.
- All human space is *designated* to support and control the desired behaviors.” (Crowe, 1991, pg. 33).

By using these concepts as a guide, “space may be evaluated by asking the following types of questions:

Designation:

- What is the designated purpose of this space?
- What was it originally intended to be used for?
- How well does the space support its current use?
- Is there conflict?

Definition:

- How is the space defined?
- Is it clear who owns it?
- Where are its borders?
- Are there social or cultural definitions that affect how the space is used?
- Are the legal or administrative rules clearly set out and reinforced in policy?
- Are there signs?
- Is there conflict or confusion between the designated purpose and definition?

Design:

- How well does the physical design support the intended function?

- How well does the physical design support the definition of the desired or accepted behaviors?
- Does the physical design conflict with or impede the productive use of the space or the proper functioning of the intended human activity?
- Is there confusion or conflict in the manner in which the physical design is intended to control behavior?" (Crowe, 1991, pg. 33-34)

By using the "Three D" approach, activity placement can be designed to promote improved natural surveillance, access control, and territoriality. A specific strategy to achieve this might include designing the site so that the normal activities of personnel are located in areas that will allow them to observe and take ownership of the space.

Possible outdoor activities include athletics, eating, and smoking.

5. **Maintenance** – encourages upkeep and continual re-evaluation of systems. This principle is also concerned with the image and milieu of the area. (Newman, 1972). The appearance of a place reflects the attention and care that is given to the space (Wilson & Kelling, 1982). Maintenance can influence the perception of an area's importance to the people responsible for it. If an area is perceived as important, it will appear to be more secure and there will be a sense that there is a greater likelihood of being observed and questioned. Examples of maintenance practices that influence image and milieu include keeping grass cut and vegetation healthy, and keeping buildings and other structures in good repair.

The best design approach is to incorporate a combination of all of the above principles. For example, you can have excellent natural surveillance, but potential offenders must perceive that unauthorized intrusion will evoke protective territorial behavior responses from the users. If people observe inappropriate behavior but do nothing about it then natural surveillance will not work (Crowe, 1991).

CHAPTER THREE

TERRORISM AND RECENT TERRORIST EVENTS

Overview

The section of the report will examine force protection, and terrorism. It will look at why these terrorism and force protection issues are a concern for the Department of Defense (DOD). A description of the effects of bomb blasts on buildings will be given. This section will also examine the following recent acts of terrorism and discuss them in relationship to the use of CPTED concepts:

- *U.S. Marine barracks, Beirut, Lebanon*
- *Khobar Towers, Dhahran Air Base, Saudi Arabia*
- *Federal Building, Oklahoma City*
- *U.S. Embassies in Nairobi and Dar es Salaam.*

A projection will be made on how the use of the CPTED techniques could have increased the security of the facilities.

Force Protection

In order to do a comprehensive design or plan for a facility, it is important to have a thorough understanding of why the design is being done, and what it is meant to accomplish. Therefore, when doing an antiterrorism design it is important to understand what terrorism is and the concepts connected with it. The basic terms and concepts associated with terrorism are being reviewed in order to promote this understanding.

When considering terrorism in context with the military, many people associate the term "force protection" with antiterrorism. However, force protection is actually a general Department of Defense (DOD) term that refers to measures designed to deter any type of threat to military service members, their families, DOD civilians, and the facilities and equipment which support them in the execution of responsibilities. These measures

include ways to mitigate against not only terrorists, but any threat that affects the ability of a person or facility to carry out their mission, including natural disasters and more common crimes such as theft. For the purpose of this report the term "force protection" will be used to indicate antiterrorism. "Antiterrorism" indicates a defensive stance, as compared to the term "counterterrorism", which is associated with offensive measures (DOD 0-2000.12-H).

DOD Priority

Force protection is a priority for DOD since defense personnel are the largest single contingent of U.S. Government representatives abroad. Because they are symbols of the U.S. Government, DOD personnel have been targets of terrorist attacks for many years. Between 1971 and 1992 there were over 140 separate terrorist incidents against DOD-affiliated personnel and installation, resulting in nearly 300 dead and more than 200 injured (DOD 0-2000.12-H). The recent attacks on U.S. soil have increased concern that U.S. military installations within the United States could also be targeted. Increasingly high-ranking military officials have listed force protection as a top priority. Quotes such as the following from Secretary of Defense William J. Perry illustrate both the concern and the commitment of officials for force protection measures:

"... Force protection measures, such as moving the location of our forces and building barriers, cannot eliminate the risk to our forces – but they can minimize those risks. Indeed, force protection is a key part of every military mission – it is my top priority whenever I approve a military operation or a training exercise." *Secretary of Defense William J. Perry, August 6, 1997* [1].

Terrorism

There is a broad range of definitions of terrorism, many of which contain different elements. Most definitions of terrorism include the calculated or premeditated use of violence to achieve a goal (Bolz, Dudonis, and Schulz, 1990). Definitions of terrorism differ, even within the U.S. Government.

- The Federal Bureau of Investigation (FBI) defines it as "... the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."
- The U.S. Department of State (DOS) defines terrorism as "... premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine state agents, usually intended to influence an audience."
- The Department of Defense (DOD) defines terrorism as "The calculated use of violence or threat of violence to inculcate fear; intended to coerce or try to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological." (DOD 0-2000.12-H).

Botz, Dudonis, and Schulz, in The Counter-Terrorism Handbook (1990), identify the following universal elements or commonalties of terrorist activities:

- 1) The use of violence to persuade
- 2) Selection of targets and victims for maximum propaganda value
- 3) The use of unprovoked attacks
- 4) Maximum publicity at minimum risk

- 5) The use of surprise to circumvent countermeasures
- 6) Threats, harassment, and violence is used to create an atmosphere of fear.
- 7) Disregard for or of women and children as victims
- 8) Propaganda is used to maximize the effect of violence
- 9) Loyalty only to themselves or kindred groups

It is important to understand common elements of terrorism and why particular targets are selected, both in order to come up with strategies to effectively combat terrorism, and to understand why particular strategies should work.

Identifying targets

Most terrorists see any target as fair game. In some cases the more important or revered a potential target, the better it is in a terrorists' eyes because it will create a more significant reaction from the public (Livingstone, 1982). The selection of a target by a terrorist is often a product of careful consideration. Three factors typically form the basis for a terrorist's decision on what target to select. The first factor is the *type of weapons* available to the terrorist. The second factor is *opportunity*, or the vulnerability of the target. And the third is the *goal or effect* the terrorist hopes to achieve through his action. (Livingstone, 1982).

The goal of a terrorist attack may be *symbolic*, it can *represent allegiance*, or *punishment*, or it may be a part of a *military type objective*. Or it can also be a combination of all of the above. A majority of targets are symbolic: they are selected both for what they represent and in order to convey a specific message to a specific audience. Some experts say that much of the effectiveness of terrorism is due to its

symbolic nature. It is possible that both the attack on the Marine barracks in Beirut and the attack on Khobar Towers in Saudi Arabia were symbolic acts against U.S. - as represented by the military personnel who lived in those complexes. A great deal of targeting is based on the terrorist's allegiance to a group or community. Targets are selected because they represent "the other side" in a conflict that the terrorist or his organization is involved in (Livingstone, 1982).

Targeting can also be based on the concept of punishment. If the terrorist believes he or his organization has been victimized, the terrorist may choose a target in order to cause harm to the opponent. (Livingstone, 1982). One of the theories regarding the reason behind the attack on the Federal building in Oklahoma City by militia sympathizers was that it represented, in part, a retaliation against the government seizure of the militia compound in Waco, Texas. A target may also be chosen because it has objective military importance. Military type targets are chosen because their elimination will undermine the efficiency of an enemy's operation. (Livingstone, 1982).

Tactics

There are several types of tactics terrorist employ to carry out their objective of violence. The most common terrorist tactics, in order of relative frequency, include:

1. Bombing
2. Assassinations and assaults
3. Kidnapping
4. Hostage-taking/skyjacking/barricade situations (Bolz, Dudonis, and Schulz, 1990).

According to Botz, Dudonis and Schulz, bombings are the most frequent type of terrorist tactic, accounting for approximately 80% of terrorist-related violence. Reasons why terrorists prefer bombings to other types of violence include the following:

1. Bombing gains media attention, particularly if the target is highly visible or symbolic.
2. Bombing is a cheap and efficient way to attack a facility.
3. Bombing can be accomplished with a small number of personnel.
4. There is minimal risk of the bombers being detected or apprehended.
5. Bombing is inexpensive in comparison with alternatives such as kidnapping or hostage taking.
6. Random bombings make considerable impact on the population, since more people fear a bomb attack than fear being kidnapped or taken hostage.
7. Explosives are readily available through theft, sympathetic support, or purchase (Bolz, Dudonis, and Schulz, 1990).

Due to the prevalence of bombings as a means for terrorists to inflict violence, facility protection efforts usually involve concentrating on the protection of structures and personnel from the effects of bomb blasts as the primary tactic to increase force protection. The act of increasing physical protection is, in and of itself, a potentially effective strategy for force protection. "In mounting a bombing campaign ... terrorists undertake a great deal of reconnaissance and normally select whichever target looks most vulnerable ... They select the easiest target ... Like water, terrorists flow along the path of least resistance" (Bolz, Dudonis, and Schulz, 1990, pg. 40).

Antiterrorism

The views of experts on the potential for effective antiterrorism strategies are positive:

"Since the intention of the terrorist is to instill fear into the population at large, there is a common motivation to the criminal acts they perpetrate. Because there is a common element to terrorism, counterterrorism has a foundation on which to base defensive strategies and tactics. Anything that can be done to reduce fear and anxiety among the general population is an effective defense against terrorism" (Bolz, Dudonis, and Schulz, 1990, pg. 1).

"Terrorist groups are independent in that they follow their individual convictions, yet united in the intentional destruction of established order. Terrorists are, in a word, predictable. Their actions create victims beyond the range of their intended targets. Yet they are also human and fallible, which affords society and opportunity to protect itself" (Bolz, Dudonis, and Schulz, 1990, pg. xiii).

As mentioned above, understanding some of the basic elements of terrorism can be useful in developing antiterrorism strategies.

Terrorism differs from other crimes in several respects. The probability of an attack from terrorists is small as compared to the frequency of other crimes. However, there is a much greater potential for loss of life and property (Atlas, 1995). Also, given terrorists' tendencies to be indiscriminant in their choice of targets and to disregard wholesale destruction, the emotional aftereffects can be felt by a great number of people.

The Effects of Bomb Blasts

As mentioned above, bombings are the most common type of terrorist tactics used and are usually the type of attack which facilities concentrate their force protection efforts on. When designing protection against car bombs it is helpful to have a basic understanding of the type of damage a bomb does and how it effects structures within its

immediate proximity. Casualties from a bomb blast can be the result of direct blast effects such as blast pressure, building collapse, debris impact, fire, smoke, or a variety of other causes. The extent of the damage to a structure depends on the *building design*, the *type of explosive* used, and *the location of the explosive* relative to the building (National Research Council, 1995).

Building design is related to architectural hardening, or actual architectural elements and building techniques used to make a building more difficult to destroy. Architectural hardening can be very expensive, whether the building is existing or in the design stage (National Research Council, 1995, Nadis, 1996). While it may be recommended for some buildings (depending on the level of threat and the vulnerability of the structure) this paper is concentrating on a planning and site design approach to antiterrorism, and so will not discuss physical hardening of buildings.

The type and size of an explosive will determine its destructive potential. Explosive materials release a large amount of energy in a short amount of time. If the speed of the reaction is faster than the speed of the explosive's sound, than the bomb is considered to be a "high explosive". "High explosives produce a shock wave along with gas ... The effect of (these) explosives on structures are directly related to the stress-wave propagation as well as impact and missile penetration" (National Research Council, 1995, pg. 28-29.) If the blast occurs inside a structure, the effects are multiplied due to the pressure being reflected. If the blast occurs at a sufficient distance from the structure, all of the building elements will provide some degree of resistance, although they may deform to some extent. If the blast occurs close to a wall or floor, some degree of

disintegration may occur, causing fragments to come off and be propelled as missiles (National Research Council, 1995).

The force of an explosion falls off drastically over distance (Jehl, 1996, Nadis, 1996). The further away the bomb is located, the more rapidly the pressure decreases. Figure 3.1 uses the front elevation of the Murrah Federal Building in Oklahoma City, to illustrate the decrease in pressure (in pounds per square inch) as the distance from the point of detonation increases.

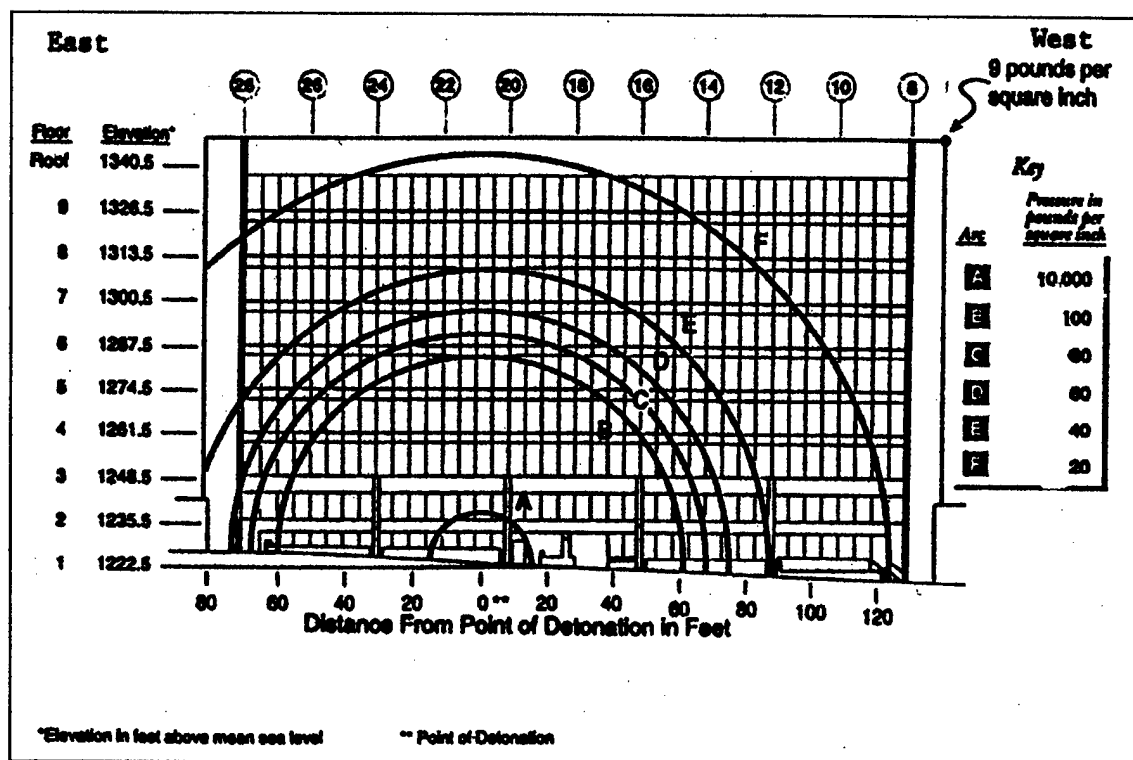


Figure 3.1: Peak Overpressures on North Elevation of Murrah Federal Building.
Source: Journal of Performance of Constructed Facilities, August 1998, pg. 115.

Most experts agree that distance is the most effective means of minimizing the effects of bomb blasts (National Research Council, 1995, Jehl, 1996). CPTED's use of

space as a form of access control is one of the reasons it can be an effective deterrent against terrorist attacks.

Recent Terrorist Events

There have been several attacks on military and federal facilities in the recent years. These attacks both indicate possible patterns for future terrorist attacks, and they illustrate the need for increased facility planning and security. Reviews of several significant attacks follow. In these reviews, projections are made as to how CPTED techniques could have been applied to increase the targets' security.

U.S. Marine barracks, Beirut, Lebanon

The attack on the U.S. Marine headquarters and barracks building in Beirut, Lebanon on October 23, 1983, was perhaps one of the most significant in terms of raising the awareness of the need for protection for military facilities. The attack resulted in 241 men being killed, the largest number of military personnel killed in a single attack since Pearl Harbor (Beck, 1983; Thomas, 1984). The Marines were in Lebanon as a high-profile, peace-keeping force working with the Lebanese to keep the Beirut airport open to commercial flights (Banta, 1983).

The attack was perpetrated by a suicide bomber who rammed his way into the Marine compound and into the lobby of the building containing the barracks with a truck containing an estimated 12,000 pounds of explosives. The truck, a type commonly used around the airport, approached the facility from the direction of Beirut, driving south along the main highway to the airport around 6:20 am. It passed an unmanned Lebanese

perimeter guard post and turned into the airport parking lot. There, within view of a Marine guard, it circled the parking lot twice then turned north, gathering speed. It then crashed through a row of concertina wire, past two marine sentry guards, whose M-16s (guns) were unloaded, and through an open rear gate into the compound and the building, as illustrated in Figure 3.2 (Beck, 1989; Thomas, 1984). Note that a more recent article indicates that the wire mesh fence shown running across the parking lot in Figure 3.2 may not have existed (Thomas, 1984).

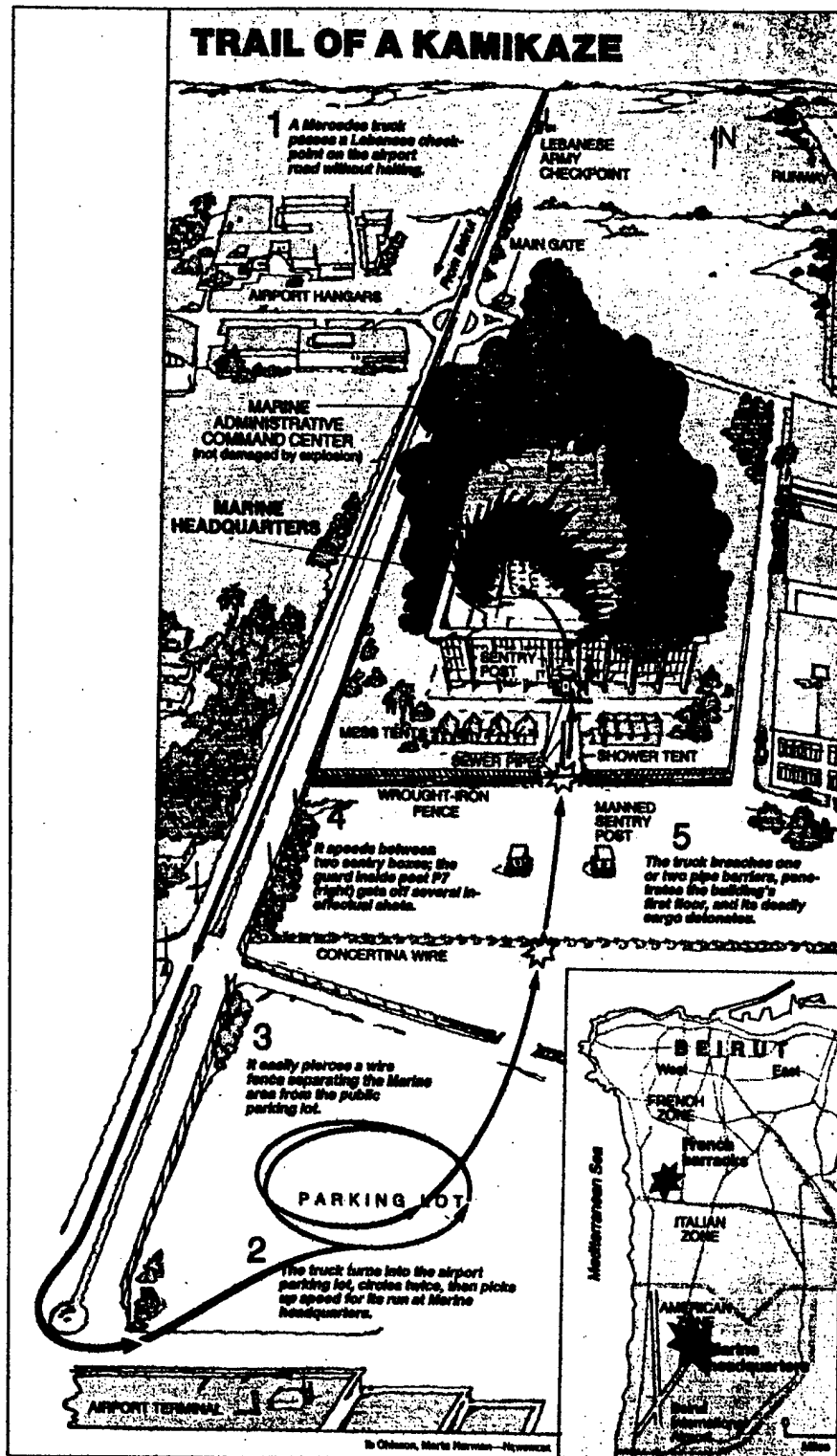


Figure 3.2: Route of terrorist through the Marine compound.
Beirut, Lebanon, October 1983.
Source: Newsweek, Nov. 7, 1983, pg. 87.

The layout and use of the compound defied almost all of the CPTED principles:

Territoriality

The congressional subcommittee's report on the incident indicated that an hour and 20 minutes before the attack, a truck, possibly the one used in the bombing, circled with its lights off in the parking lot outside the Marine headquarters. A car entered the parking lot about five minutes before the attack, and its driver began taking pictures of the building. The report indicated that the guard thought this was "kind of strange" but that the Marines did not try to load their rifles until the truck was speeding past them on its final approach (Thomas, 1984).

That these abnormal behaviors did not inspire the guards to do more than they did would seem to indicate a lack of territoriality or personal ownership on their part. Perhaps they did not feel a sense of responsibility or concern because these events were happening "on the other side of the line" from what they saw as the boundary of their compound. The parking lot appears to have been a general use lot for the airport. If it had been assigned specifically to the Marine headquarters, perhaps the sense of territoriality might have been heightened.

Surveillance

The compound relied on an organizational approach to surveillance in that they had sentries placed around the compound. However, the Lebanese checkpoint, which may have been able to provide advanced warning about an attack, was unmanned (Beck, 1983). As indicated above, not only were the guards on duty unable to respond quickly

enough to provide adequate notice to the occupants of the buildings, they also did not pick up on previous activity that indicated they might be in danger.

As was mentioned previously in this report, even if surveillance is excellent, potential offenders must also perceive that unauthorized intrusion will evoke protective territorial behavior responses from the users. As noted previously, if personnel observe inappropriate behavior but do nothing about it, surveillance will not work (Crowe, 1991). In this case the weakness seems to be more of a territoriality issue than a lack of actual surveillance.

Access Control

The compound used both organizational and "semi-natural" forms of access control. They used a system of barriers around the compound but the barriers were ineffective for the type of attack they faced. The truck had a relatively straight line of approach from the parking lot to the building, though it is estimated that it was only going 30 M.P.H. when it passed the Marine's posts. Although there were also an iron gate and iron pipes between the parking lot and the building, the only operating barrier was the roll of concertina wire. According to one of the guards it "just made a popping sound" as the truck drove through, "like someone walking over twigs" (Thomas, 1984, pg. 56). Figure 3.3 illustrates some of the problems with the barrier effectiveness.

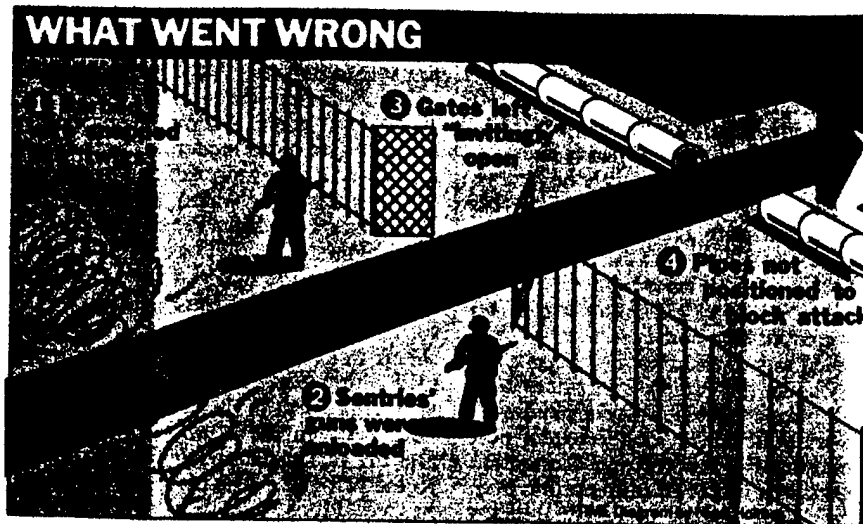


Figure 3.3: Marine Barracks, Beirut - Lack of barrier effectiveness.
Source: Time, January 2, 1984, pg. 56.

That more effective methods of access control could have been used in this case seems relatively obvious. Traffic calming devices such as speed bumps or curving the roads may have slowed the truck down even more, but the most effective form of access control would probably have been a series of barriers that would have denied the truck access to the actual building. If done in an aesthetic manner, these barriers may have even increased the sense of territoriality for the Marines.

Activity Placement

There does not appear to have been any attempt to use activity placement to improve natural surveillance, access control or territoriality. In fact, one article noted the building that housed the barracks also housed Marine antitank missiles (Beck, 1983).

Maintenance

General appearance and maintenance was not described in the articles about this incident. However, the gate in front of the compound was left open during a time when the Marines had been inundated with intelligence reports warnings against terrorist attacks, (Thomas, 1984) indicating a lack of attention to even the few barriers that were in place.

Khobar Towers, Dhahran Air Base, Saudi Arabia

The most recent large-scale attack against a military facility occurred on June 25, 1996, with the bombing of Khobar Towers, and Air Force housing complex in Dhahran, Saudi Arabia. The attack claimed the lives of 19 service members and injured 300. The personnel were part of a force of approximately 5,000 military personnel who were in Saudi Arabia to enforce the authority of the Saudi royal house and ultimately, to protect U.S. oil interests (Dickey, 1996).

The blast was caused by a fuel truck packed with 3,000 – 5,000 pounds of high explosives that was thought to be parked beside the compound fence by Muslim extremists. Even though the truck was parked outside of the complex, it was less than 100 feet from Building 131, one of the housing complexes. Although several buildings were damaged, 18 of the 19 people who died were in Building 131 (Jehl, 1996). Figure 3.4 illustrates the layout of the compound and describes the sequence of events.

A Bomb—And 3 Minutes' Warning

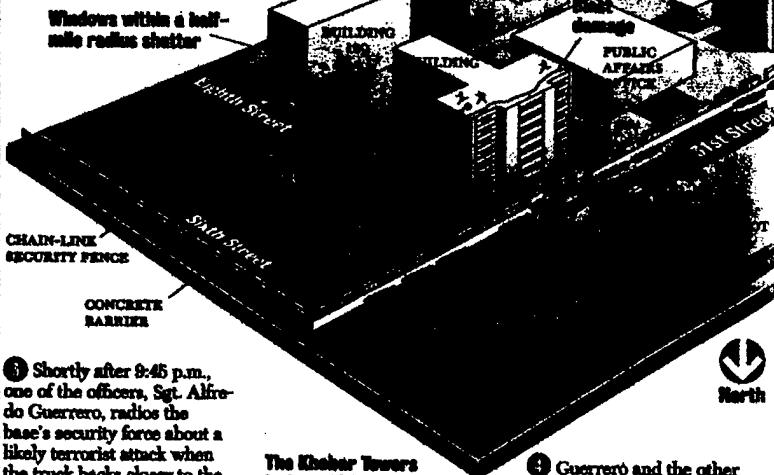
The men of the 4404th Air Wing had long feared that Khobar Towers Building 131, home to many of its men, was too near the road, too open to attack. Last Tuesday their fears were realized when a truck carrying a massive bomb exploded outside the building, leaving 19 dead, 300 wounded and a 35-foot-deep crater.

A Scramble—Then Horror and Heroism

① At about 8:45 p.m., a large tanker truck and an accompanying white car drive into the parking lot of a nearby park in a clockwise direction. The lot, which is unguarded and open to anyone, abuts the Khobar Towers complex, where American, British and French troops are housed.

② Three U.S. Air Force officers, manning a guard post only recently created atop Khobar Building 131, are the first to notice something peculiar as the truck and car roll onto 81st Street, running along the security fence.

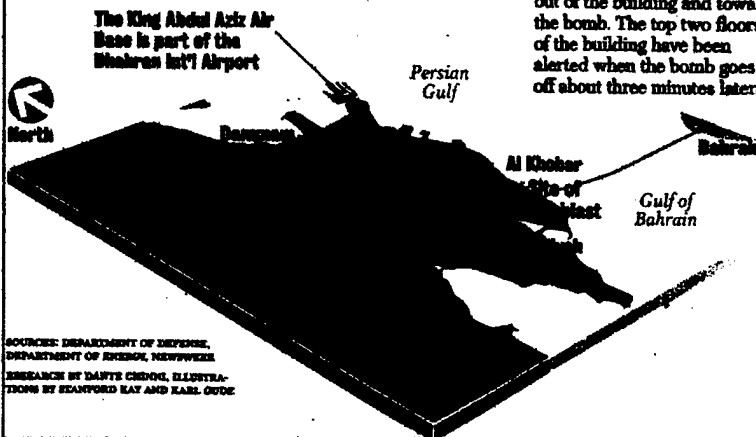
All buildings shown are heavily damaged or destroyed



③ Shortly after 9:45 p.m., one of the officers, Sgt. Alfredo Guerrero, radios the base's security force about a likely terrorist attack when the truck backs closer to the hedge and its driver jumps into the accompanying car, which speeds away from the truck and out of the lot.

The Khobar Towers include 42 buildings and serve as a barracks for American troops.

④ Guerrero and the other guards scramble into the building, and go door to door, warning residents. Fire alarms cannot be used because they could lead soldiers out of the building and toward the bomb. The top two floors of the building have been alerted when the bomb goes off about three minutes later.



SOURCES: DEPARTMENT OF DEFENSE, DEPARTMENT OF ENERGY, NEWSWEEK
RESEARCH BY DANIE CHENG, ILLUSTRATIONS BY SEAFORD RAY AND KAREL OUDER

Figure 3.4: Layout and events of Khobar Towers bombing.
Source: Newsweek, July 8, 1996, pg. 24.

The Air Force was under a high threat of terrorism and both had and were still attempting to harden the complex at the time of the attack (Kitfield, 1997). Sentries had been placed on the roofs of several buildings. Concrete barriers had been placed around the perimeter of the facility, and a second set of barriers was planned. A security assessment had been done and included a recommendation to put protective plastic film on the compound's windows to prevent a blast from turning them into lethal shards of flying glass. There were several difficulties with hardening this particular building, the main one of which was the lack of standoff distance. This had been identified as a problem and the local Saudi military commanders had been approached with a request to extend the northern edge of the facility boundary to 400 feet, but had balked in granting it, and so the issue had not been pursued further (Jehl, 1996).

Territoriality and Surveillance

Increasing territoriality and surveillance would probably not have been a great deal of help in this case. Both Saudi and American security personnel noticed the vehicle. A Saudi police officer called for a tow-truck. An American sentry on the rooftop saw the driver and his accomplices flee the truck and sounded the alarm. An Air Force security policeman dialed the number to activate a loud speaker warning system, but the bomb went off before a general warning could be issued (Jehl, 1996).

Access control

Officials said the major focus of the security precautions in Dhahran had been to prevent a truck or car from penetrating the compound itself. This may go back to the

principle of territoriality and the tendency to think that one's responsibility stops at the fence line. The presence of the sentries and the concern over the lack of stand-off distance argue against this. In any case, access control to the compound was a priority and barriers had been erected to keep unwanted personnel out. One of the problems was that the threat assessment was only based on a 200 pound explosive. The bomb that destroyed Khobar towers was the largest of its kind that the Saudis had encountered (Jehl, 1996).

Activity Placement

The main CPTED principle that applies to this case is activity placement. Given the threat assessment and the vulnerability of the structure, the housing of military personnel was probably not an appropriate activity for Building 131. Apparently there were other residential spaces in more secure buildings on the Khobar facility where the occupants of Building 131 could have been moved, but that option had not been considered (Jehl, 1996).

Federal Building, Oklahoma City

The deadliest terrorist attack in the United States occurred on April 19, 1995, with the bombing of the Alfred P. Murrah Federal Building in Oklahoma City (ENR, 1995). The blast occurred when a truck containing approximately 4,000 pounds of high explosives parked on the street in front of the building about 10-15 feet from the north façade and about 40-50 feet from the east building end. The blast destroyed several structural columns, causing the upper floors of the nine story building to collapse,

resulting in 168 deaths, and numerous injuries. The blast also caused an estimated \$50 million in damages to the approximately 75 buildings in the area (National Research Council, 1995). Figure 3.5 shows the damages to the Federal building and several other buildings in the area.

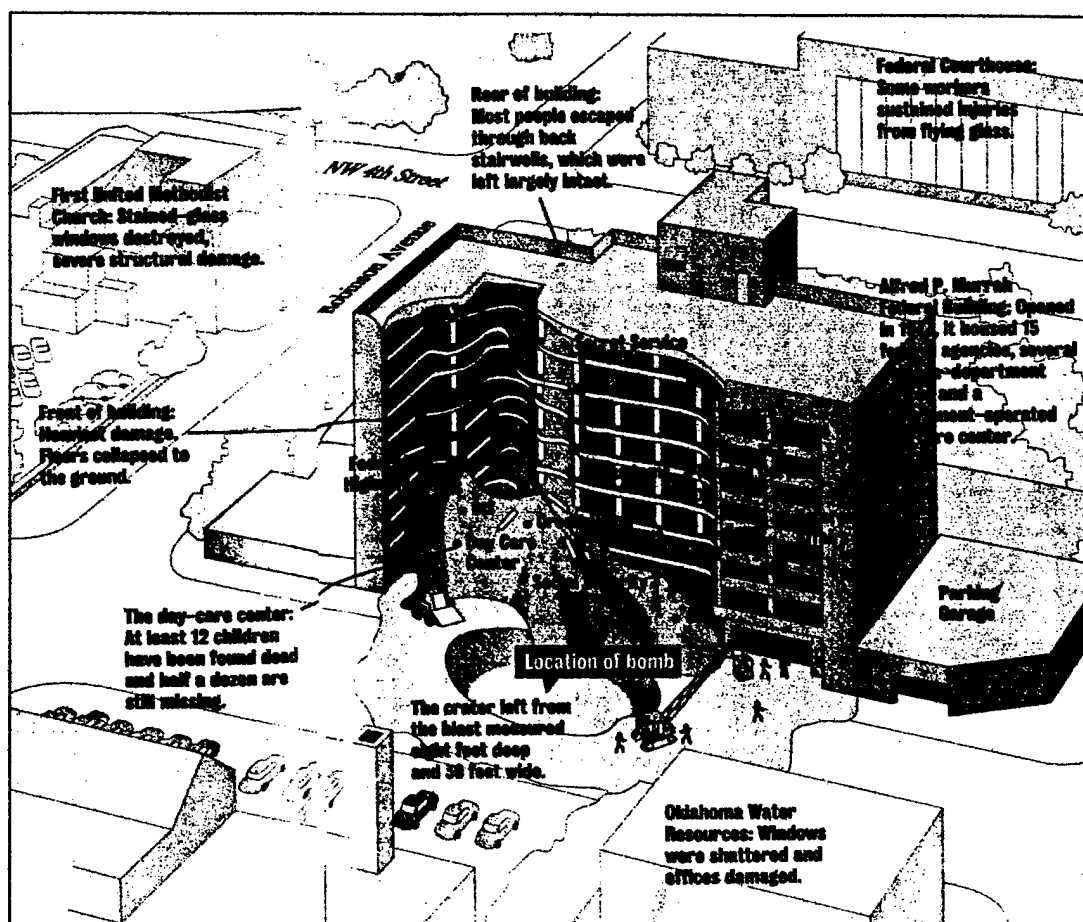


Figure 3.5: Damage to Alfred P. Murrah Federal Building and surrounding structures. Source: Newsweek, May 1, 1995, pp. 44-45.

Although the Federal Building is not a military facility, it is significant because the terrorist act occurred in the United States. The main weakness of this site was its lack of set back from the street on the building's North side. As the plan of the site (Figure 3.6) indicates, the other sides of the building appear more protected.

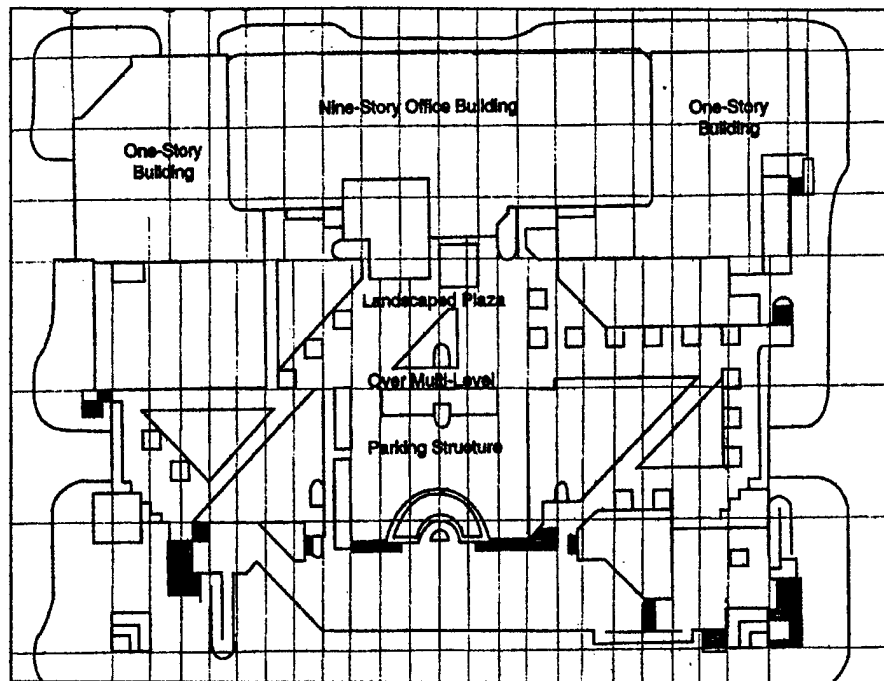


Figure 3.6: Site Plan for Murrah Building.

Source: *Journal of Performance of Constructed Facilities*, August 1998, p. 121.

Territoriality and Surveillance

Although it is speculation, it can be conjectured that the interior layout of the building did not allow for much natural surveillance. The first floor was partially set back from the street, and the columns in front may have created blind spots from the inside. This lack of surveillance, along with its location next to a public street and sidewalk, almost certainly did not lend itself to encouraging a sense of territoriality in the building's occupants. That the driver of the truck had time to get away after he had left the truck indicates it was on the street for several minutes before the bomb went off. It is doubtful, given the environment, that many people noticed it or questioned it being there.

Access control

The lack of a set back from the street allowed easy car and truck access to the front of the building.

Activity Placement

The interior layout of building's office space was not available, but a reception desk or offices facing out onto the street may have improved visibility. Territoriality would have been more difficult to achieve given the public nature of the street and sidewalk immediately adjacent to the building.

U.S. Embassies in Nairobi and Dar es Salaam.

One of the most recent attacks on U.S. facilities occurred on August 7, 1998. There were actually two attacks, occurring almost simultaneously at the U.S. Embassies in Nairobi, Kenya and Dar es Salaam, Tanzania. The blasts killed 247 people in Nairobi, including 12 Americans, and 10 people in Tanzania. Over 4,000 people were injured (The Gainesville Sun, Aug 12, 1998). Neither one of the buildings met the current State Department security standards and set-back requirements. The embassies had received waivers because terrorism was not considered a serious threat to U.S. embassies in Africa (Greve, 1998).

Nairobi, Kenya

The Nairobi Embassy was located at an intersection and faces Moi Avenue, a busy public street. It has no security fence in front, but was surrounded by an 8-foot-high

steel fence on the other three sides. The bomb was apparently located in the parking lot behind the embassy or in an alley between the embassy and another building. The blast gutted the rear half of the U.S. Embassy and leveled a three-story building containing a secretarial school next door. GS Aug. 9. An illustration of the embassy site is shown in Figure 3.7.

Dar es Salaam, Tanzania

The embassy in Tanzania, a former private mansion, was set back from the street. There was also a 9-foot masonry wall around the perimeter of the compound with guardhouses at two entrances (Cooperman, 1998). The bomb, which was reportedly planted in a gasoline tank, went off near the entrance of the embassy building. The front of the building was destroyed and a side wall and trees were toppled (McKinley, 1998). A partial illustration of the embassy is shown in Figure 3.7.

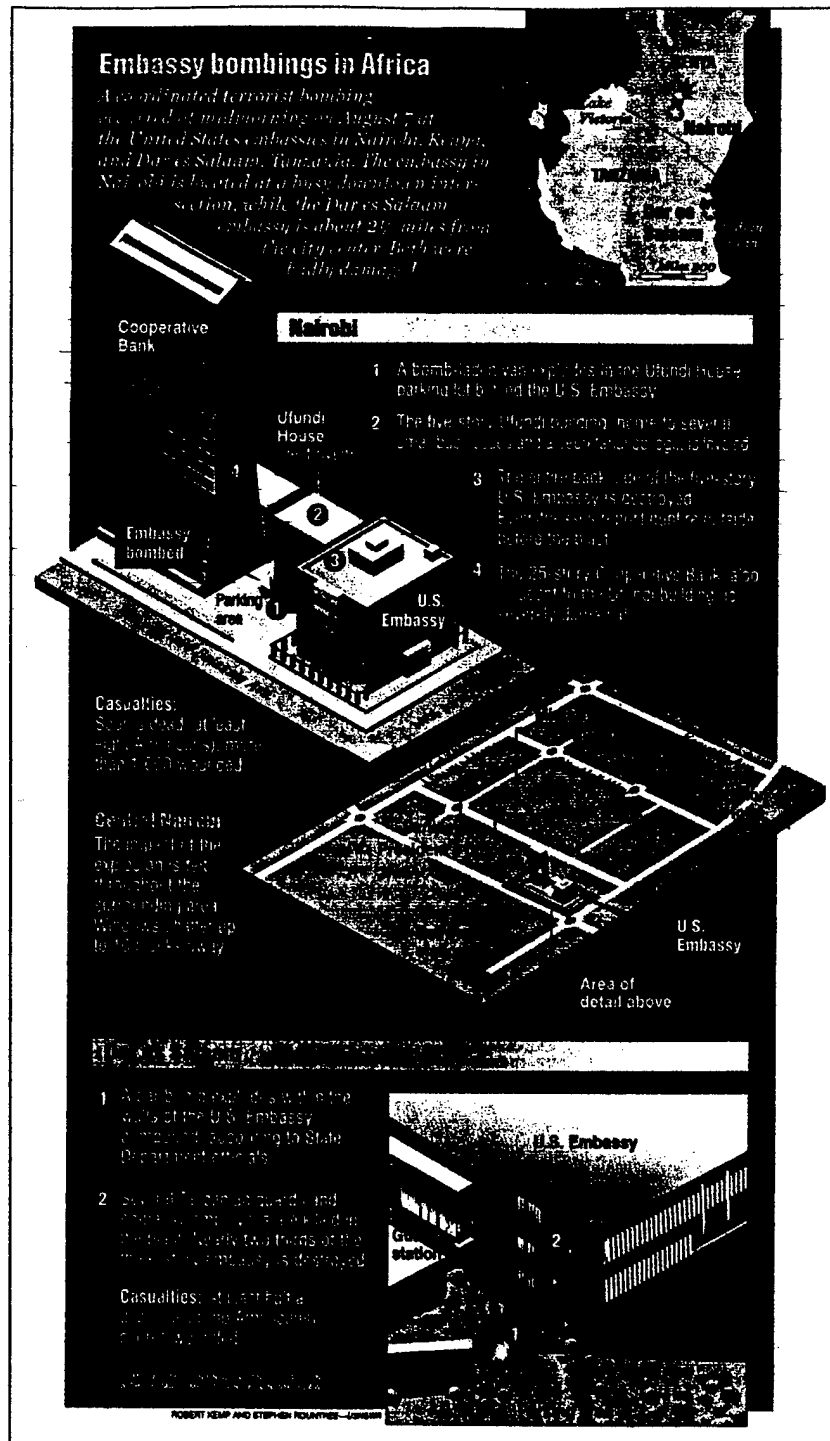


Figure 3.7: Embassy sites in Africa.
Source: U.S. News and World Report, Aug. 17/24, 1998, p. 12.

Territoriality

It is difficult to speculate as to the territoriality of the people in the embassies. Not enough of the facts are available to give a clear picture of what happened.

Surveillance and Access control

Organizational and mechanical surveillance and access control was used at both embassies, including cameras, metal detectors, and Marines guards (Greve, 1998). There were cameras at the embassy in Kenya that were pointed towards the back parking lot, unfortunately they were for monitoring only and did not record the bombing (GS, Aug. 12). However, observers did claim to see men running from the parking lot firing machine guns. And although there was a nine foot fence around the Tanzanian embassy compound, the car containing the explosive was parked inside, meaning that it had somehow passed by the security guards (Cooperman, 1998).

Conclusion

As noted, many of the more recent bombing attacks have been against facilities that were close to public streets. Although it may be nearly impossible to improve access control in existing buildings that can not be set back from a public roadway, other CPTED principles can increase security to some extent. Natural surveillance can be improved through activity placement and interior office layout, which may also increase territoriality. Surveillance can also be improved through mechanical, electrical and organizational means. One thing to remember about organizational access control or surveillance is that humans are fallible and they can make mistakes. They are much more

likely to question abnormal behavior if they feel a sense of ownership towards the area they are charged with protecting.

On most military bases, roads and parking can and should be moved or rerouted, especially if the threat warrants it. In the case of military facilities, the most difficult structures to protect will probably be the ones that are near to the perimeter of the facility. In this case, it is critical to review what activities are taking place in the building and move them to a more secure location if they are perceived to be threatened.

CHAPTER FOUR

CPTED GUIDELINES FOR FORCE PROTECTION

Overview

Based on the comprehensive planning process, a general set of guidelines will be developed that can be used by planners and facility personnel to develop plans for their facilities. A step by step description of this process will be included in this chapter. By using this process, a comprehensive plan can be developed that will increase force protection through the use of the five CPTED principles.

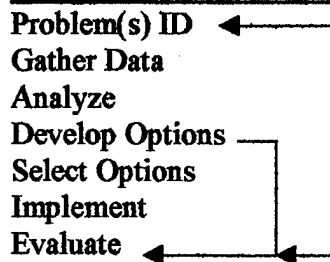
Guidelines for Using CPTED and Planning in Force Protection

This section will put in place a general set of guidelines that can be used by planners and facility personnel to increase force protection through the use of CPTED.

One of the weaknesses of the Navy antiterrorism and security policy, which will be discussed in detail in Chapter 6, is the lack of emphasis on comprehensive base planning.

When doing an antiterrorism plan for a facility is important to consider the base in its entirety and also the surrounding community, especially adjacent land uses. In keeping with the concept of comprehensive planning, the guide for antiterrorism design should be based on the comprehensive planning model that follows:

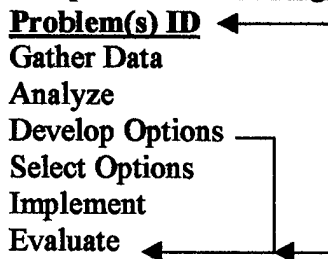
Comprehensive Planning Model:



Comprehensive Planning

Comprehensive planning, also referred to as master, general, or development planning, is “planning for the totality rather than for one or several of its constituent parts” (Branch, 1998, pg. 3). Models for comprehensive planning usually contain the above steps. The model is basically a rational, decision making process (Alexander, 1986). The whole process should undergo continual reevaluation, as indicated by the arrows in the model above.

Comprehensive Planning Model:



Problem identification is the basic process of identifying a problem and the goals and objectives for solving the problem. In antiterrorism design, this step would consist of *the basic threat assessment phase identified in the DOD handbook*, in other words, pinpointing possible targets on a facility and assessing the likelihood that they will be attacked. This step will help determine how much effort and how many resources should be committed to the force protection effort, and where these resources should be concentrated.

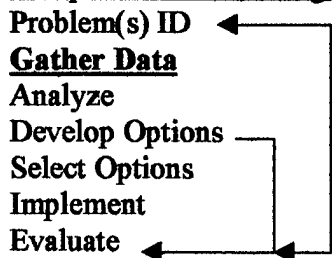
The NAVFAC Security Engineering Course identifies the following types of activities as likely candidates for terrorist attacks:

- Command facilities
- Security facilities

- Fuel facilities
- Parked aircraft
- Computer facilities
- Nuclear facilities

Although this list is a good starting place for target identification, it is important to remember that it is not all-inclusive. A specific mission or even location of an activity or facility that is not listed may increase the potential of its being a target. It is also possible that a place can be a target by virtue of the surrounding land uses. NISCOM is one resource that can assist a Navy facility in making threat assessment determinations. NAVFAC Engineering Field Divisions, and the Naval Facilities Engineering Service Center may also have this capability.

Comprehensive Planning Model:



The *data-gathering* phase is one of the most important steps in the planning process. All decisions should be based on data. Therefore, the better and more comprehensive the data available, the better informed the decision can be.

Crowe identifies five basic types of information that need to be collected and used when designing physical space:

- Crime analysis information
- Demographic information

- Land use information (pedestrian and traffic flows and boundaries)
- Observations
- Resident or user interviews (Crowe, 1991).

Crime analysis information

This is data that can be used to determine and describe possible threats. Possible crime analysis data includes:

- The type and strength of bomb that will most likely be used (should be available from NAVFAC or NISCOM)
- Crime rate and types of crime in the surrounding community (available at local police department). Two patterns to look for in crime data are geographic location of crimes and similar types of offenses (Crowe, 1991).

Demographic information

Demographic information describes the nature of the population in an area. It can be useful for activity placement and strategies to improve territoriality. For a military facility it can include:

- job types
- breakdowns of rate and rank (may be available at Personnel Support Departments (PSDs) or from individual activities. City managers or planning departments should have this information for the surrounding community.)

Land use information

Land use information indicates the physical layouts and uses of land. It may be useful to depict this type of information graphically, in map format. It can show natural boundaries and other important geographical features of a base. It includes:

- Specific locations of roads and buildings
- Pedestrian and traffic flows and boundaries
- Location of different activities on and around a facility (available at Navy Public Works Department and local planning and public works departments.)

Observations

Conducting formal or informal visual reviews of a physical area is the best way to get first-hand knowledge of who uses an area, different ways in which the area is used, and when those uses take place (Crowe, 1991). This can be very useful in developing strategies for natural surveillance, territoriality and activity placement. Useful observations may include:

- pedestrian or vehicle counts
- maintenance levels
- the degree of proprietary behavior exhibited by users
- patterns of activity on the site

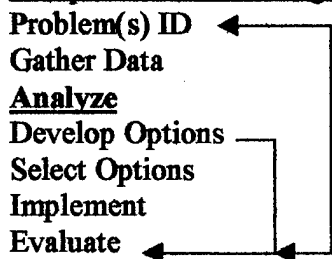
Resident or user interviews

Interviews can provide information that fills in or balances the other data sources (Crowe, 1991). How people identify with their surroundings and their perceptions about

how the physical environment affects them can be very useful. Perceptions can help identify unsafe areas, areas that tend to be avoided, and other physical weaknesses of a facility that the project team would not necessarily observe during infrequent visits. How personnel use or would like to use their space can help determine effective activity placement.

It might be useful to consider interviewing residents outside the installation gates, in adjacent areas/communities as well as personnel who work in the actual facility. One fundamental question here would be their sense of connection with the base such that they might recognize and report "abnormal users" to base authorities before they were on base.

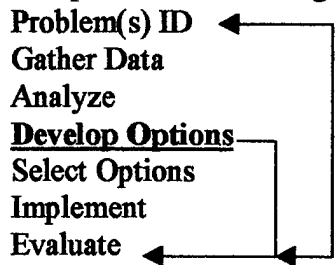
Comprehensive Planning Model:



Analyzing data is using the information that has been gathered to identify strengths and weaknesses of a plan, facility, area, or even of the data and resources themselves. An example of this is the use of bomb blast information to identify standoff distance. The identification of standoff distances is usually the basis or starting point of an antiterrorism design, so it is a critical piece of information. The NAVFAC Security Engineering Course uses a 1000-pound explosive as a standard for determining standoff distance. The DoD instruction recommends a 100-foot minimum setback from the perimeter of the facility. NAVFAC Engineering Field Divisions, and the Naval Facilities

Engineering Service Center are resources that can calculate bomb blast radiuses and help determine appropriate standoff distances and thus help base/facilities planners analyze the vulnerabilities of their plans and designs.

Comprehensive Planning Model:



After the data is analyzed, *design options are developed* based on the analysis and on the stated goals and objectives of the project. Developing options is a design process. It is circular to the extent that it has several phases, all which follow a modified form of the comprehensive planning model. Developing options involves a series of negotiations with a number of concerned parties. To develop design options based on CPTED techniques, the five basic CPTED concepts should be considered in relationship to the data that was collected.

The design process usually begins with several preliminary ideas or options that are developed from project team “brain storming” sessions. After the brain storming, the ideas are consolidated into several options based on overall strategies. These options are presented either formally or informally. They usually include graphic representations of the ideas being presented. Formal presentations may be made in front of major players and decision-makers and often include a large number of interested parties. Informal presentations may be presentations made in front of the actual project team, or may be in the form of packets of information that are distributed and reviewed by the interested

parties on an individual basis. This step may also include a combination of both formal and informal presentations, depending on how complex the problem is.

The project team may include a number of concerned parties including: planners, security personnel, facility personnel, the customers or the people working or living in the buildings that are being considered targets for the purpose of hardening, and people from the surrounding community. Even if one of these groups is not on the actual project team, they may have ideas or concerns that have not previously been addressed and therefore might be valuable additions to review sessions or presentations. All of the above groups would be important as interviewees in the data gathering phase in order to gather the appropriate information to do the project.

Each of these players can contribute certain valuable ideas and information to the design process. For example: in deciding activity placement, the activity user is critical in determining if the plan will work with the daily activities and routines that occur in his or her space. They will be able to gauge if the particular elements of the plan are practical or not. Working with the project may also help them formulate ideas about the arrangement of activities that the other team members were not able to pick up on in interviews or observations of the site.

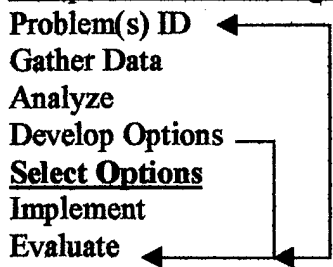
The planner can provide a "big picture" view of the base as well as projections for future use that will help in developing a *comprehensive* plan. The planner can also provide a background in physical design that other players may not possess. Either the planners or the facility personnel may also have a background in engineering, which would allow them to have a clearer understanding of the actual effects of a bomb blast on a building. Facility personnel are in charge of the physical functioning and upkeep of the

base. They are also the ones who will probably have to request the funding for any physical changes to the base, so it is critical that they understand the process and why the changes are being requested.

The security officer is the person who is actually designated the responsibility for force protection. He can be critical in getting the process started and in helping to assess the actual needs of the facility. The security officer can provide a background in the elements and theories of how physical security works. He will be more familiar with the strengths and weaknesses of the base and security force than other participants, including reasonable force response times, threat types and levels, and other important data.

The local citizens can be useful in developing an interface between the base and the community. They can help gauge the effectiveness of zones and perimeters. They can also identify threats outside of the limits of the facility that the base personnel may not be aware of. If they know that a threat exists, they may be able to help identify it before it reaches the facility. This can be particularly important if there is a vulnerable building or activity close to the periphery of the base. Open communications with the community can also help create an atmosphere of partnership and understanding between the military and civilian populations.

Comprehensive Planning Model:



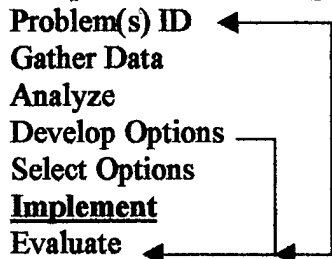
Once design options are developed, the options should be evaluated in order to identify any problems or conflicts, such as fire and safety access to buildings, etc. As indicated by the arrows in the model, the planning process should be repeated to solve identified problems. Once the problems are worked out, the *most reasonable options should be selected*.

After the preliminary ideas have been critiqued, intermediate designs should be developed and presented following the same process. If the problem is not complex, the intermediate phase can be skipped. Decision making personnel should be present at the final design presentation, whether it is preliminary or intermediate. It is important for the implementation phase of the project to have the people in charge understand what is being proposed and the reasons behind the proposals. While the intermediate design can be reviewed formally or informally, a formal presentation is recommended. Hearing the ideas of one person spoken vocally tends to inspire more ideas in the listeners, which can result in useful discussion and informal (on the spot) problem solving. A separate informal review after the presentation may also be useful.

The final design is developed based on the feedback from the presentations and reviews. Again, this design should also go through a review, but it can be informal. The purpose of a final review is to simply take one last look at the final design to make sure

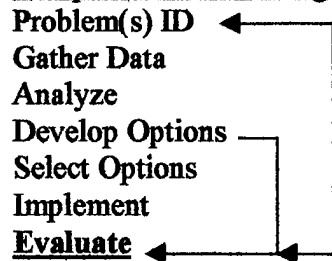
all of the recommendations have been included and work together in a logical, comprehensive manner.

Comprehensive Planning Model:



The *implementation* phase involves the process of putting the selected option or options in place. It is important to already have decision-making personnel on board with the project in order to successfully carry out this phase. Implementation requires resources and the power to use them. The distribution of resources can be very political. If decision making personnel, such as the Commanding Officer of the base, are enthusiastic about the project and support it, obtaining resources to implement the project is much easier.

Comprehensive Planning Model:



Once the selected options have been implemented they should be reevaluated on a regular basis to determine if they remain effective. *Evaluation* should follow the planning process, as indicated by the arrows in the model. A formal time schedule is

recommended to determine who will review the plan, when the plan will be reviewed, and what the reviewers will look for. The base master plan is already scheduled to be reviewed by the planning department on a regular basis. Incorporating the antiterrorism plan into the base master plan could help expedite the evaluation process. But it is important to make sure all of the critical players, including the security personnel and the activity users get a chance to take part in the review.

CHAPTER FIVE

ADAPTING CPTED TO FORCE PROTECTION – JIAF-EAST CASE STUDY

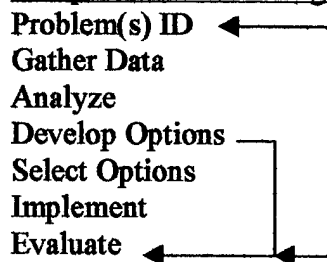
Overview

The JIATF-EAST project was undertaken by a multidisciplinary team from the University of Florida (UF) at the request of the facility's Physical Security Officer, Mr. Alan Mather. Mr. Mather also acted as the client representative and the project liaison. The project provides a good illustration of the steps in the comprehensive planning model and will be used to assist in explaining the process of incorporating CPTED into force protection.

Process

Although the comprehensive planning model discussed in Chapter 4 was not specifically followed in the design of the JIATF-EAST project, the steps that were taken during the actual design process are easily related to the model. The design for the antiterrorism plan for the JIATF-EAST facility will be used to illustrate how the comprehensive planning model can be used to design a force protection plan using CPTED techniques. As noted in the previous section, the model contains the following steps:

Comprehensive Planning Model:



Problem Identification

Problem identification is the process of identifying a problem and determining the goals and objectives for solving it.

Problem: JIATF-EAST's mission to detect and monitor aerial and maritime drug trafficking in the Atlantic, Caribbean and Eastern Pacific transit zones made it particularly vulnerable to criminals and terrorists connected to the drug trade. Its location on Truman Annex at Naval Air Station Key West, Florida complicated the problem due to the open base policy and its proximity to a major tourist destination. The true southern point of the U.S. is also located on the facility. The four-building complex that housed the activity did not have sufficient standoff distance to withstand the effects of a truck or car bomb attack. U.S. Atlantic Command LEPS Team conducted a formal threat assessment for the base the week of 7-11 April 1997. The assessment confirmed that the facility was an open target and vulnerable to attacks from Narco-terrorists.

Goal: While the military representatives admitted they could block off access points to the buildings with traffic barriers, they wanted a solution that was more attractive and subtle in its design. The military representatives were interested in a redesign of the vehicle and personnel access to the building to reduce the opportunity of attacks and damage to the facility. A fence around the four building and enhanced lighting in the parking areas were important but secondary interests of the facility personnel. Figure 5.1 is a plan of the JIATF-EAST complex.

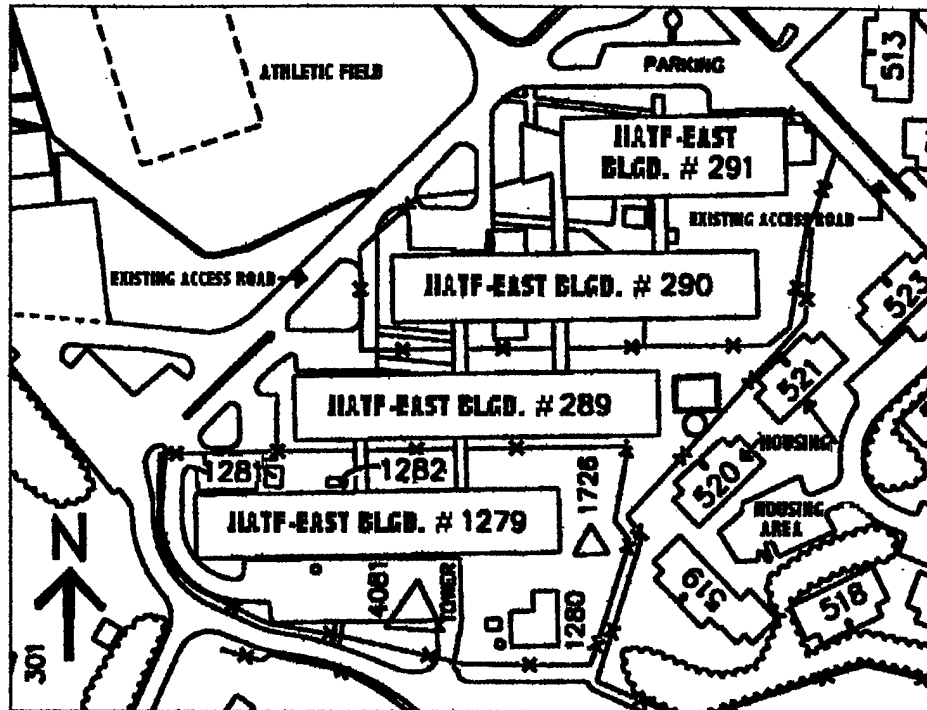


Figure 5.1: Plan of the JIATF-EAST complex.
Original Map Source: University of Florida College of Architecture

Gather Data

The five types of information that needs to be collected when designing physical space were identified and discussed in Chapter 4 and included:

- Crime analysis information
- Demographic information
- Land use information
- Observations
- Resident or user interviews (Crowe, 1991).

Participants

An interdisciplinary team of faculty, students, and advisors gathered the data and produced the actual project design. The backgrounds of the team members included security, architecture, planning and landscape architecture. Primary responsibility for the actual project design was given to two UF classes, a graduate level Defensible Space in Urban Design course, taught in the Urban and Regional Planning Department (URP) by Dr. Richard Schneider, and a graduate/undergraduate level Landscape Architecture Studio, taught by Professor Bob Grist.

Other team members included Professor Steven Luoni, from the UF Department of Architecture, who consulted on the architectural aspects of the project. Dr. Ruth Steiner, from URP, consulted on traffic planning. Officer Sterling Keys, from the City of Gainesville Police Department, provided consultation on crime prevention and other security matters.

Crime analysis information

Three experts were consulted as part of the research process to provide crime analysis information. JIATF-EAST's Security Officer, Mr. Alan Mather, and his staff, provided information on areas that they had already identified as possible security problems and situations that existed on the facility and in the surrounding area. (One of the island's high crime areas is Bahama Village, located directly adjacent to the north-east side of the JIATF-EAST annex.)

Mr. Brian Barstow, from the Naval Facilities Engineering Command provided a personal presentation to the classes in which he described the method for calculating the blast analysis for the base, and provided the limits of blast exposure to the buildings given the explosive strength he was designing for. Mr. Barstow did the analysis based on a 1000-kg (2,205-lb.) car bomb, which was based in part on the Oklahoma City blast. He did not want the impact to the actual building complex to be above 3 pounds per square inch (psi), which meant a standoff distance of 250 feet from building complex was required as shown in Figure 5.2. (Also see Blast Analysis Report – Appendix A).

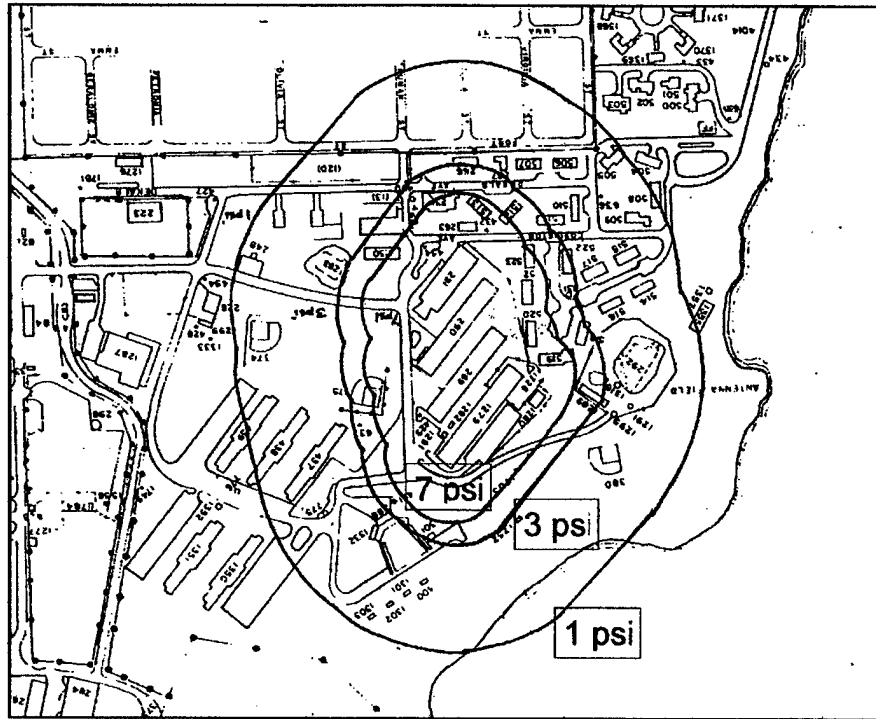


Figure 5.2: Plan of the JIATF-EAST complex with blast radius included.
Original Map Source: University of Florida College of Architecture

Security expert Mr. Dan Briggs, from SEMCO Security Consultants, in Jacksonville, FL, provided information on the concept of a layered security system and

on some of the technological (mechanical and electrical) devices that are available for security. Devices described include electrical access control technology, exterior sensors, and other surveillance equipment.

Demographic information

Mr. Mather and his staff provided information about the existing activities and personnel distributions on the facility. In addition to JIATF-EAST, other tenants in the four-building complex include CARIBROC and Project FLAMINGO, an operation of the National Security Agency (NSA). Both are equally sensitive facilities that are also considered possible targets for terrorist bomb attacks. JIATF-EAST is located in two of the four two-story structures in the complex – Building 291 and 290. It shares part of Building 290 with CARIBROC. Building 1279, the southern-most building, is occupied on the first floor by several JIATF-EAST directorates and on the second floor by Project Flamingo. CARIBROC also shares part of Building 289 with Project Flamingo. The remainder of Building 289 is unoccupied, although there are plans to move additional personnel into it in the future. (See proceeding Figure 5.1.)

In addition to the different tenants, sections of the buildings have different security level requirements, so personnel with lower security levels cannot go through the actual building complex, but have to go outside and walk around the buildings to get from one section to another. One of the concerns of the security personnel is that classified documents sometimes need to be carried from one office to another and the couriers have to walk outside to do this.

Land use information

Mr. Alan Mather and his staff also provided information about the existing physical layout of the facility, including specific areas that he had already identified as security weaknesses. Other land uses on the facility include a Moral, Welfare and Recreation (MWR) area to the south of the complex that hopes to expand in the future. This expanded area would provide recreational facilities for retired and active duty military and DOD civilian personnel. Complicating the land use pattern is a regularly operating church, Building 230, that is located to the north, directly across from the main entrance of the JIATF-EAST complex. A large enlisted barracks, Buildings 437-439, is located across a sports field from the complex. Family housing is located immediately behind the complex, to the east. An illustration of the complex and the surrounding facility with site constraints is shown in Figure 5.3.

The Naval Air Station at Truman Annex is also included in the military downsizing program known as Base Reorganization and Closing (BRAC). Due to this, part of the base will be transferred to the City of Key West for public or private development. Mr. Scott Legeaux from Bermillo Associates, a Miami-based A&E firm, discussed the adjacent BRAC property and the possible affect it could have on the future configuration of the base. The BRAC property is located east of the church and includes the Seminole Battery, ruins of a historic munitions storage and gun battery located to the north of the complex, directly behind the church.

Observations

Primary research included site visits and client critiques and feedback. Two site visits were conducted at the base in Key West. The first visit was done by a group of faculty during the spring of 1997, in order to more clearly define the scope of the project. The second visit was with the students in the fall of 1997, and included physical field research of the site and facilities.

Resident or user interviews

Our main client representative, Mr. Mather, provided information and was the primary person interviewed; however, the students also talked to other personnel on and around the site during the site visit.

Analyze

Analyzing data involves using the information that has been gathered to identify strengths and weaknesses. Once the data was collected the classes analyzed the data both independently and collectively with a view towards developing a comprehensive design strategy.

Constraints

Several specific areas of concern were identified either by the students and faculty or by the client representatives. These areas of concern fell into three basic categories: general, vehicular or travel oriented, and building layout.

Major design constraints included an active church/chapel located immediately next to the complex, and the Bahama Village and BRAC property (including the Seminole Battery), immediately adjacent to the site. Further, the base commander does not directly control the MWR property and military recreational area at the south side of the site.

One of the major travel related concerns was the uncontrolled access to the site, both vehicular and pedestrian, due to the open base policy. Many of Key West's tourists walk or drive onto the base without realizing it is a military installation, or that there are sensitive facilities in the area. Access into the base is possible through two separate gates, one at United Street and one at Southard Street. It was also observed that the residents of the military housing next to the complex had been using a short cut that went directly through the JIATF-EAST complex.

Another major concern was that vehicular traffic was able to use roads located only a few yards away from the buildings, allowing no standoff distance. Parking for the buildings was located immediately adjacent to two of the buildings and is inadequate for the number of staff working in the complex. Parking for the nearby chapel was also a concern. The loading dock, which needed to be accessible to 18-wheeler trucks, was perceived to be another weak point in the complex. Several other security issues were identified including possible access across the open athletic field to the north and vehicular access to the dumpster near the rear walkway between building 291 and building 290. The chain link fence surrounding a couple of the compound buildings (note it did not surround all four) was also in poor condition and needed repair. Several of the above site constraints are identified in Figure 5.3.

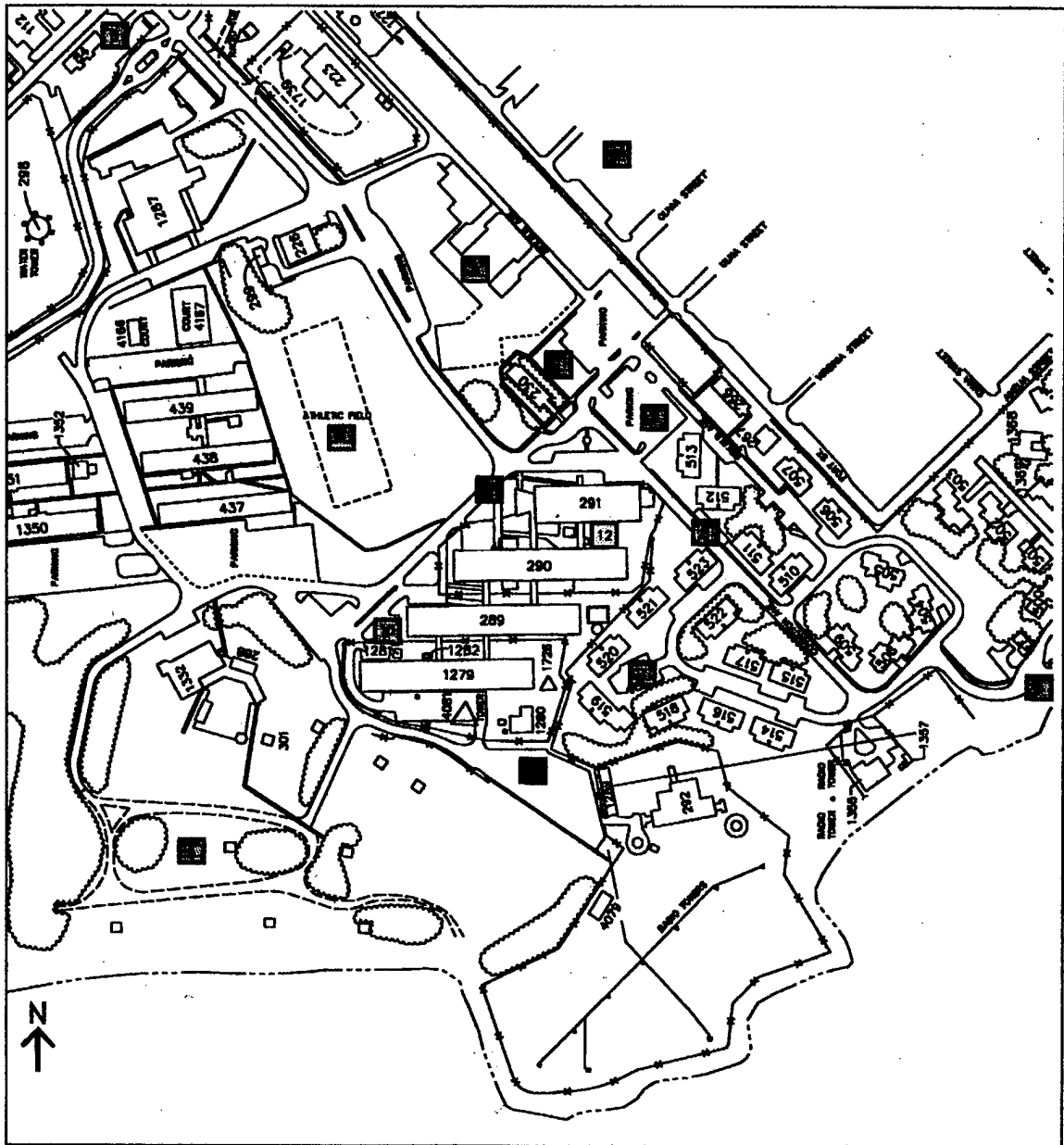


Figure 5.3: Partial plan of Naval Air Station Truman Annex with Site Constraints:
 (1) Church, (2) Bahama village, (3) Seminole Battery, (4) MWR Property, (5) United Street (gate beyond), (6) Southard Street (gate beyond), (7) Military Housing, (8) Roads adjacent to Complex, (9) Parking adjacent to Complex, (10) Proposed Loading Dock, (11) Athletic Field, (12) Dumpsters.

Original Map Source: University of Florida College of Architecture

The building layout concerns were varied. The entrances to the various structures were not well defined and did not lead to a sense of territoriality. They were also not very secure and tended to have blind spots, blocked by concrete stairwell screens. The four buildings had different security ratings; however, personnel needed to be able to move from one building to another in a secure fashion. VIP's sometimes visited the facility, which traditionally required a ceremonial entrance be available so they could be dropped off immediately adjacent to the building. As previously noted fences were chain link and did not surround the whole complex and the fences were old and in need of repair. Lighting and CCTV coverage were considered inadequate around some of the buildings and around the parking lots (see insert section for Design Option 1 at the back of this section).

Opportunities

The major opportunity present in this project was that the base personnel (particularly the security officer) were willing to be flexible and open to new approaches to security, which allowed the CPTED/planning and design approach to be explored. They had rejected the extreme target hardening that others wanted to impose initially and so were willing to look at other options. Another opportunity identified was that there was enough open space available around the complex to reconfigure the roads and parking areas to achieve the desired vehicular setback distances.

Design Options

After the data was analyzed, design options were developed based on the analysis and on the stated goals and objectives of the project. There were three phases of design options for the JIATF-EAST project. The first two of these phases went through the reevaluation process identified by the arrows in the comprehensive planning model.

Preliminary Design Options

The first round of design solutions consisted of 16 designs done by individual students in the landscape architecture studio, in consultation with the students in the URP class. These designs addressed many of the concerns found during the site visit. Based on feed back from the faculty and URP graduate students, the designs were grouped into three categories based on cost and feasibility: 1) *Economical*, 2) *Practical*, and 3) *Expensive*. Three teams were formed based on these categories in order to create a more concise, narrower set of design options, and in order to lessen the rigidity of design authorship.

Many of the preliminary designs introduced ideas that directly enforced the CPTED concepts. Some used barriers of varying types and construction, but disguised them as something that could actually serve another function, enforcing the idea of activity placement. A concrete based grouping of flagpoles near the entrance of the building was a good example of this. Several of the designs tried to bring the users out onto the site to improve surveillance. One of these ideas was to design a running path around the open field at the North side of the site. Another design built a pedestrian

boardwalk along the southwest perimeter of the site, bordering the ocean and the tower farm.

Once design options were developed they were again subjected to the planning process. Problems must be identified and analyzed based on additional data that has been gathered. Some of the preliminary designs had specific problem areas that were analyzed in the review based on the additional information from the faculty and the graduate students.

Many of the ideas were not reasonable from a cost standpoint, or were not practical. For example, one design included a moat around the main complex. This idea was borrowed from examples of historical defense, but perhaps took these a little too literally. A weakness present in most of the presentations was a lack of signage, which would enforce the concepts of territoriality and access control. Many of the preliminary designs had parking lots that were located too close to the building. There also seemed to be a heavy reliance on card swipes at entrances to parking lots and roadways in many of the designs. This led to a discussion about curving the roads, a concept borrowed from medieval times, the Asian city examples, and the Beirut and Bahrain case studies, to reduce the possibility of cars being able to accelerate on the straight road and crash through the gate arms. Several of the designs brought up issues that had not been previously discussed, such as emergency vehicle access, and separation of parking for the church, residential and recreational areas of the base, an example of zoning that enforces access control.

Intermediate Designs

As noted above, three intermediate sets of design options were developed based on the feedback from the first set of 16 options. The three intermediate designs were presented two weeks after the preliminary design presentation. During this review additional information was available from activity representatives present at the presentation. Representatives from the facility included the JIATF East Chief of Staff, Colonel Joe Gorman, USAF, the JIATF East Staff Civil Engineer, Commander Paul Mitchell, USN, Physical Security Officer Alan Mather, and Chief Warrant Officer Ronald Howell, USMC, the Counterintelligence Officer who assisted in performing the JIATF-EAST threat assessment. Also present were the chair of the URP program, the Vice Provost of the University of Florida, and students and faculty working on the project.

This presentation allowed the students to test their design concepts in public and it encouraged the feedback from the clients which was essential to producing a final design and planning solution. Comments and critiques for each of the Design Options may be found in the Appendix of this paper.

Select Options

Once design options were developed, the options were evaluated in order to identify any problems or conflicts, such as fire and safety access to buildings, etc. As indicated by the arrows in the comprehensive planning model, the planning process should be repeated to solve problems identified. Once the problems are worked out, the most reasonable options should be selected. As noted above, the military representatives

reviewed the three intermediate design options in depth and ultimately chose the aspects they liked best in each to make up the final comprehensive design. The final design is illustrated in Figure 5.4, and a color rendition of the final design is located in the appendix of this paper. The individual design elements and the CPTED principles they illustrate follows.

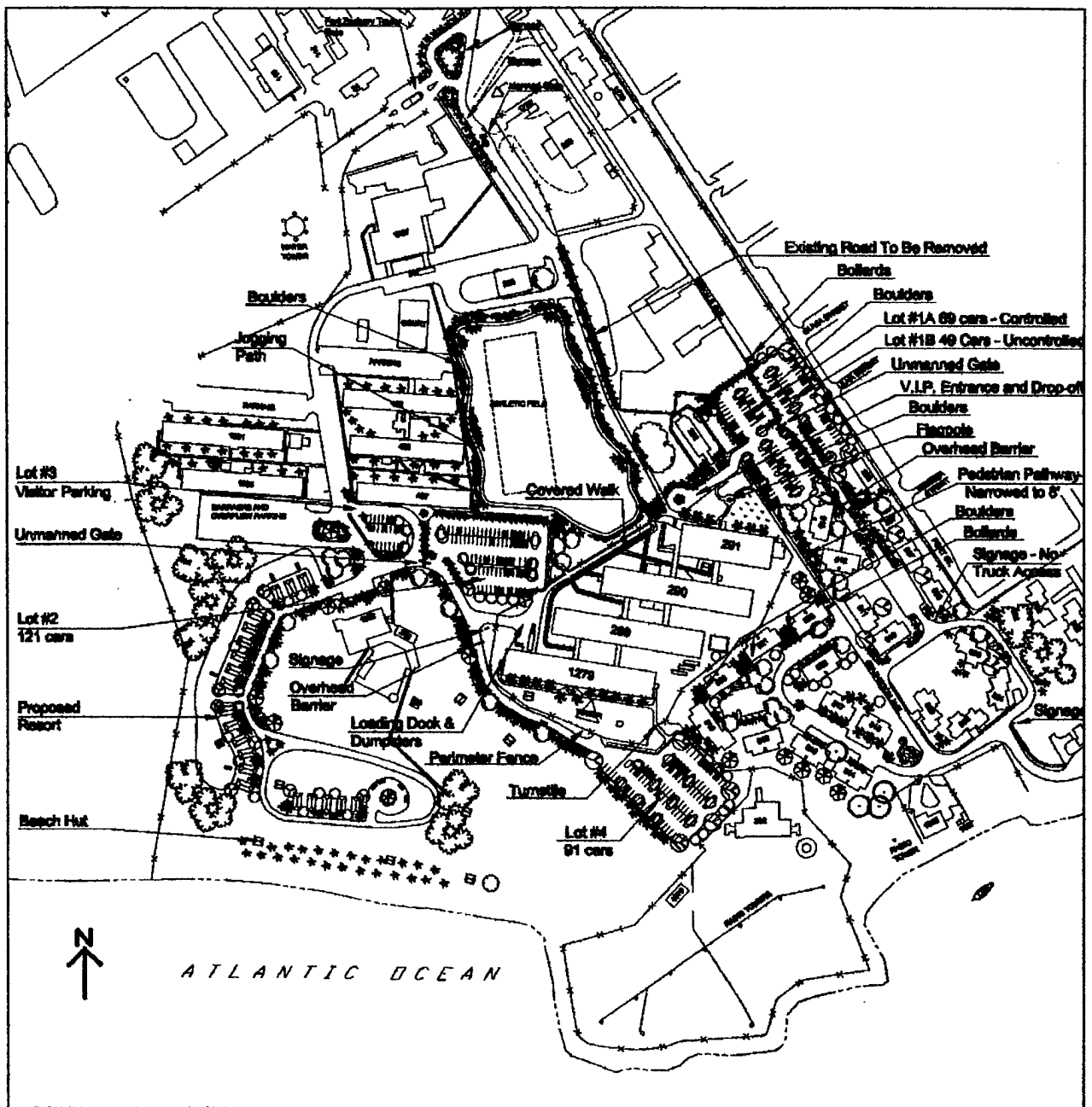


Figure 5.4: JIATF-EAST Final Design
 Original Map Source: University of Florida College of Architecture

Final Design

One of the main, overall design concepts in final design was to separate the base into several zones, cutting off access across the base in order to avoid unnecessary and unauthorized traffic near the JIATF-EAST facility. For example, the housing residents on the south-east side of the site can only enter the housing area through the United Street gate to the south-east, they can not enter the base from the Southard Street gate to the north and drive through the base. The MWR patrons and the residents of the barracks on the west side of the site can only gain access to their respective areas through the northern, Southard Street gate.

As mentioned above, a breakdown of the individual design elements and the CPTED strategies they are related to follows. The design elements are broken down and separated in order to promote a better understanding of how the individual elements illustrate the specific CPTED concepts and how all the elements combine together to create a comprehensive planning strategy for the facility.

Territoriality

(See Figure 5.5)

1. Install proper signage throughout the base to mark territory and increase the sense of territoriality; in particular, install proper signage to keep trucks from entering the Dekalb parking area.
2. Fence or barricade the north parking lot to prevent vehicle access and delineate the BRAC property from the base, which indicates territoriality.

3. Fence and landscape the Seminal Battery area in order to separate it from the base territory and identify it as part on the BRAC territory. (This is also a form of image and milieu under the maintenance principle).

Surveillance

(See Figure 5.5)

4. Provide a manned gate on Southard Street. (Also promotes access control and territorially).
5. Integration of lighting and CCTV into the design around the core buildings.

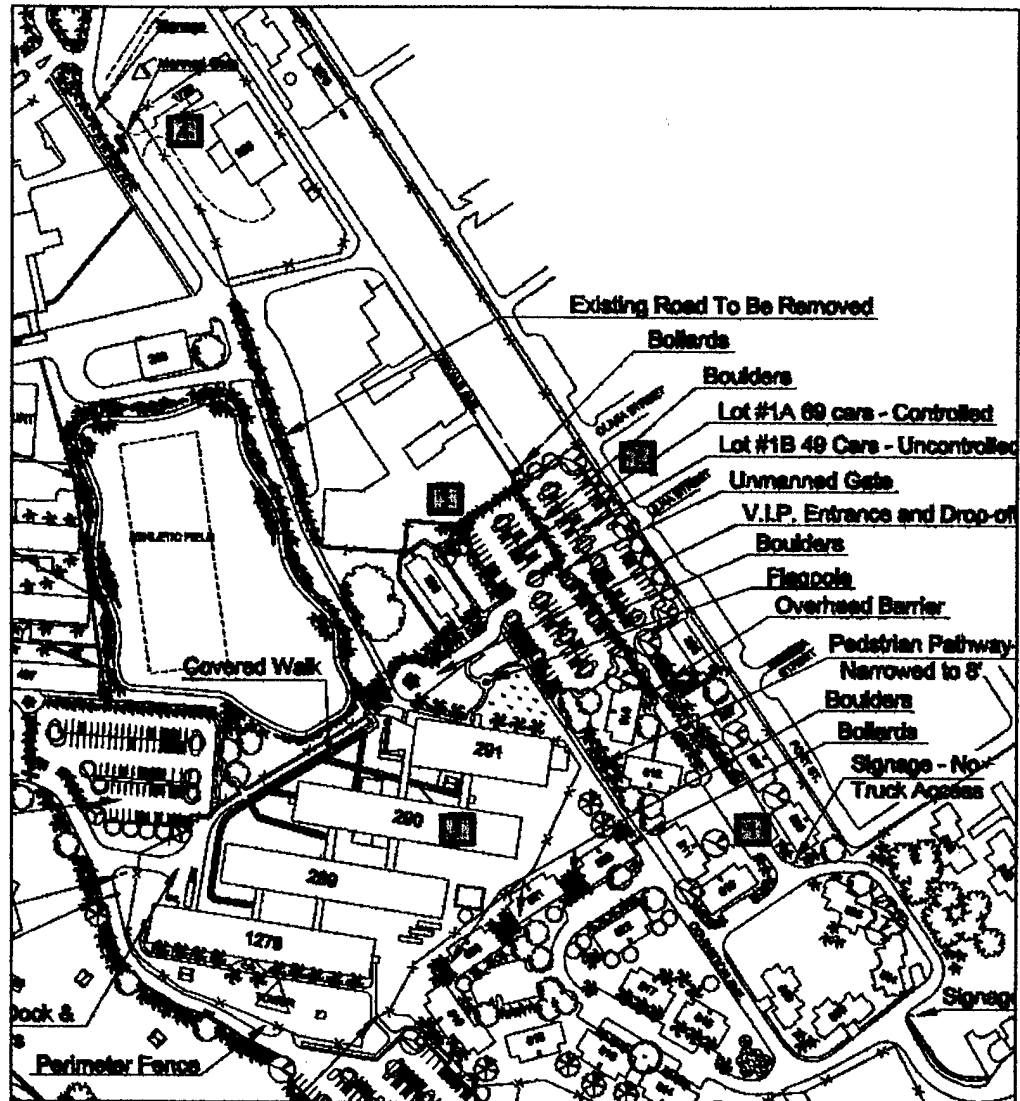


Figure 5.5: JIATF-EAST - Territoriality and Surveillance Elements
Original Map Source: University of Florida College of Architecture

Access Control

(See Figure 5.6)

6. Close off part of Covington Avenue in order to deny vehicles access immediately adjacent to the building. Close off by placing concrete or metal bollards and covering

- the asphalt with grass allowing a pedestrian walkway of 10'. This will separate the housing area from the work area, creating zones of use and mobility.
7. Put an overhead truck barrier on Dekalb Avenue and a truck turnaround to keep trucks from entering the Dekalb parking area.
 8. Expand Dekalb parking lot and provide for a controlled parking area
 9. Control use of VIP drive through card readers.
 10. Use bollards as access control to separate the Dekalb Avenue exit from the parking lot.
 11. Close off part of Southard Street in order to deny vehicles access immediately adjacent to the building and to get rid of the long straight run of road that leads to the main building. This was to be accomplished by placing concrete or metal bollards and covering the asphalt with grass allowing a pedestrian walkway of 10'.
 12. Line the athletic field with palm trees and boulders to keep vehicles from cutting across the field and approaching the buildings. (This is also a form of image and milieu under the maintenance principle).
 13. Landscape between the barracks buildings to keep vehicles from cutting across the field and approaching the buildings. (This is also a form of image and milieu under the maintenance principle).
 14. Turn Truman Avenue into an internal access path inside the new fenced area to increase access control. This will separate the work area from the recreational and barracks area, creating the zones.
 15. Install fence around all four buildings to increase access control.

16. Use a proximity card reader controlled barrier at the entrance to building 437 parking lot.
17. Provide an electric sliding gate with a proximity card reader controls as access control to a new fenced loading dock and dumpster area.
18. Put an overhead truck barrier at entrance to building 1279 parking lot.
19. Expand building 1279 parking lot and include a sidewalk and pedestrian turnstile.

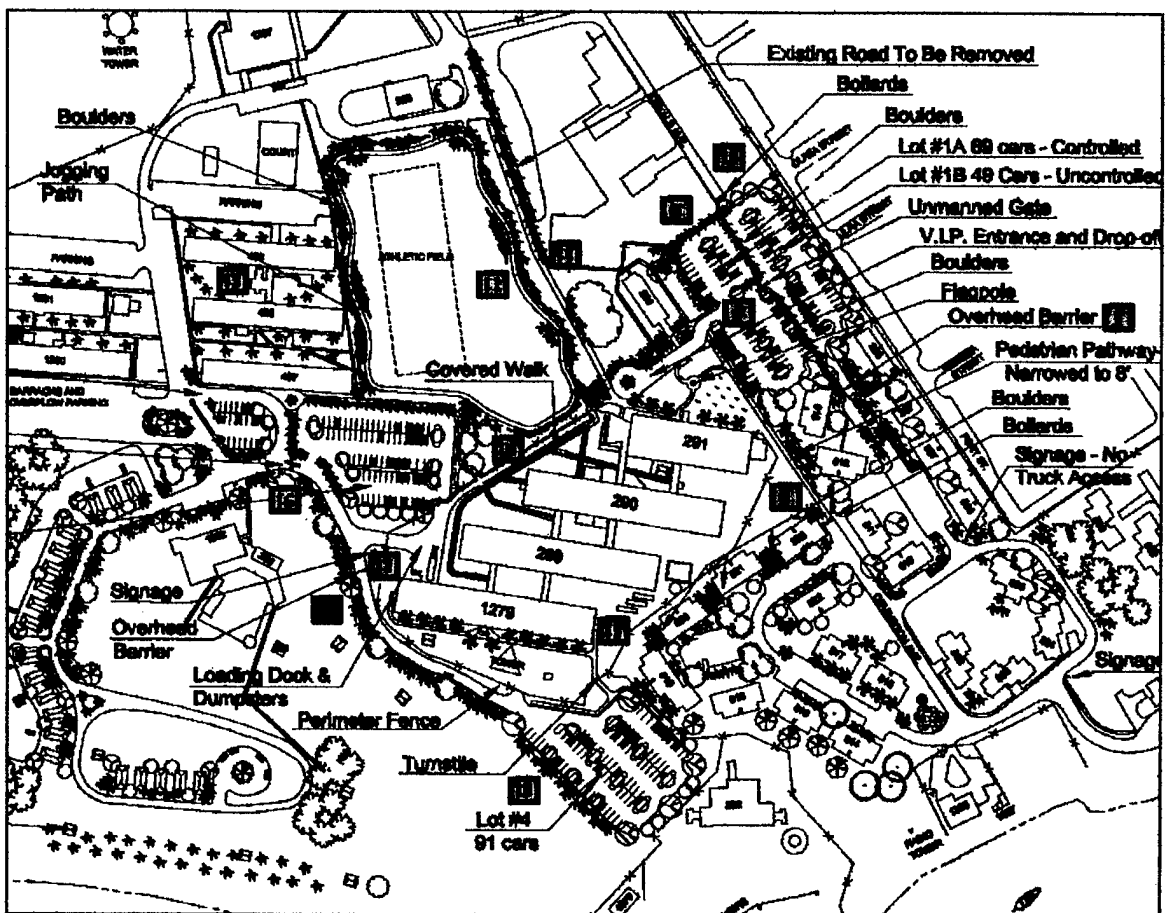


Figure 5.6: JIATF-EAST - Access Control Elements
Original Map Source: University of Florida College of Architecture

Activity Placement

(See Figure 5.7)

20. Install jogging path around the athletic field to encourage territoriality and increase surveillance. This is also a good example of activity placement, considering that many of the military personnel run as part of their daily routine and training. (It also illustrates natural surveillance and territoriality).
21. Expand building 437 parking lot and landscape with palm trees and boulders (this will provide image and milieu as well as access control.)

Maintenance

(See Figure 5.7)

22. General increase in landscaping.
23. Landscape road to building 1279 parking lot to separate the MWR property from JIATF, creating territoriality and access control through use of palm trees and boulders.
24. Eliminate parking in front of main building and landscape with flagpole arrangement to create more of a corporate image. This will also increase the sense of territoriality and the flagpoles should reduce vehicular access to the building.

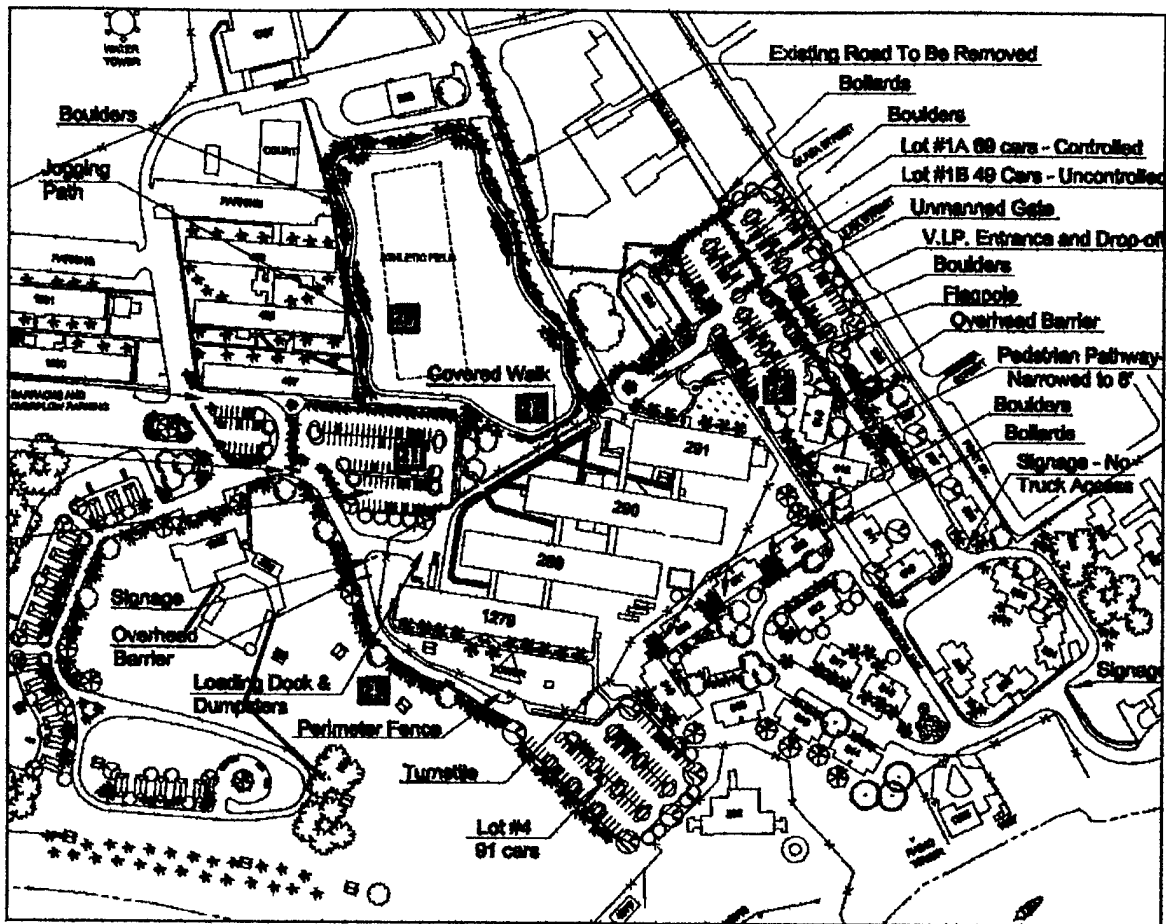


Figure 5.7: JIATF-EAST - Activity Placement and Maintenance Elements
 Original Map Source: University of Florida College of Architecture

Many of the above design strategies for the final plan for the JIATF-EAST site illustrate a combination of the five basic CPTED principles. The following matrix (Table 5.1) shows how these principles overlap for each of the individual JIATF-EAST final design elements.

Design Element	Territoriality	Surveillance	Access Control	Activity Place.	Maintenance
1. Install proper signage	X		X		
2. Fence north parking lot	X		X		
3. Fence and landscape the Seminal Battery	X		X		X
4. Manned gate on Southard St.	X	X	X		
5. Lighting & CCTV		X			
6. Close part of Covington Ave.			X		
7. Overhead truck barrier & turnaround on Dekalb Ave.	X		X		
8. Expand & control Dekalb parking	X		X	X	
9. Control use of VIP drive	X		X		
10. Separate Dekalb parking & exit	X		X		
11. Close off part of Southard St.			X		
12. Line the athletic field w/ palm trees & boulders			X		X
13. Landscape areas btwn barracks			X		X
14. Turn Truman Ave. into an internal access path	X		X		
15. Install fence around buildings	X		X		
16. Card reader at Bldg. 437 parking			X		
17. Card reader at loading dock & dumpster area.			X		
18. Overhead truck barrier at Bldg. 1279 parking lot	X		X		
19. Expand Bldg. 1279 parking, include sidewalk & turnstile.		X	X		
20. Install jogging path	X	X		X	
21. Expand Bldg. 437 parking & landscape			X	X	X
22. General increase in landscaping	X				X
23. Landscape road btwn Bldg. 1279 parking & MWR property	X		X		X
24. Eliminate parking & landscape in front of main building	X		X		X

Table 5.1: Matrix of JIATF-EAST Design Elements

The above suggestions, taken together, create a layered system of zones, blocks and barriers. The CPTED concepts were used and combined to create a comprehensive design for JIATF-EAST. The final design should improve security by hardening the targets, increasing the usefulness of the outdoor spaces, while providing an aesthetically pleasing environment in which people can live and work.

Implement

The implementation phase involves the process of putting the selected options in place. JIATF-EAST representatives were delighted with the finished product and were excited about the changes that had been recommended. Although most of the changes have not been implemented as of this time, (enhanced lighting was recently implemented) JIATF-EAST personnel submitted funding requests for the various projects and recently received \$850,000 to actually make many of the changes suggested.

Evaluate

Once the selected options have been implemented they should be reevaluated on a regular basis to determine if they remain effective. Evaluation should follow the planning process, as indicated by the arrows in the model.

This project was unusual in that it had a very diverse group of people working on it. Not only were there both military and civilian personnel working on the project, there were two separate classes representing two different academic and professional disciplines. This led to members of the group having both different approaches and different work methods. The military tradition is one of practical solutions with little

regard for aesthetics, and a heavy use of intimidating looking fences and blockades. The civilian tradition tends to be more aesthetic, but still has a tendency to rely heavily on technical devices such as electronic alarms and CCTV. The addition of the CPTED concepts puts a third, entirely new twist on the whole thought process.

The design part of the project relied on the landscape architecture class doing the actual drawings and designs and the planning class acting as CPTED consultants. The landscape architecture class was a six-hour lab. The students, who were a mix of graduates and undergraduates, tended to work long hours and tended to do much of their work immediately before the projects were due. These work methods were mainly due to the time constraints of their labor-intensive program. They were also not as familiar with the CPTED concepts and tended to be more concerned about the environmental and the aesthetic aspects of the project than were their planning counterparts.

In the graduate planning class, which was a three hour course on CPTED, the students tended to be more concerned with the concepts and they tended to want to see their ideas developed earlier. These conflicts between ideas and methodology probably led to some frustration on the part of both groups of the students, with the landscape students feeling harassed and the planning students feeling ignored, at least some of the time. Given the diversity in the group, it was difficult to see at the start of the project how an end product, that would be acceptable to all parties, would be achieved.

The process did work however. The three stages of design with their accompanying discussions and critiques achieved a process that was, in many ways, like a funnel. From an abundance of ideas, individual concepts were sifted out and agreed upon, and then molded until finally, a few were left that meshed well together into a

cohesive design. The concepts of CPTED were followed, and in many cases the ideas used to implement these concepts were both unique and effective. The comprehensiveness of the final product, and the enthusiasm of the customer, is testimony to the success of the process.

CHAPTER SIX CURRENT NAVY POLICY

Overview

The section of the report will examine the official antiterrorism and planning policy for the Navy. The policy will be reviewed in order to determine the present role of facilities planning in force protection. The current Department of Defense (DOD) Antiterrorism Handbook and the Naval Facilities Engineering Command (NAVFAC) Security Engineering Course will also be reviewed and rated on their incorporation of the CPTED principles.

Current Antiterrorism Policy

In order to determine how planning and CPTED principles could be incorporated into Navy antiterrorism policy in the future, several of the current policy guidelines were examined. Navy policy on terrorism is governed by DOD Directive O-2000.12, which establishes that it is policy "to protect DOD personnel and their families, facilities, and other material resources from terrorists acts..." (DOD O-2000.12-H, pg. 1-3). In accordance with this directive, DOD O-2000.12-H, the DOD Antiterrorism Handbook, Protection of DOD Personnel and Activities against Acts of Terrorism and Political Turbulence, came out in February of 1993. An updated instruction is currently being written, but is not available for review at this time; therefore the 1993 handbook will be used as the basis of Navy policy for this paper.

Outline of Force Protection Policy

The DOD Antiterrorism Handbook (the Handbook) is intended to be a reference document to assist DOD Components in designing, developing, implementing and evaluating effective programs to reduce the risk of terrorist attack and mitigate its effects should it occur. It is a comprehensive document divided into four major sections that cover a variety of terrorism related issues. It also contains several appendices containing useful material in list format, designed to be used for awareness or education programs.

Section one of the Handbook includes background information about terrorism, U.S. policies, structure of DOD organization, and legal constraints. Section two presents security concepts such as threat analysis and warning, risk assessment, physical security policies and physical security techniques. Section three outlines measures that can be taken by individuals to reduce personal risk. Section four addresses problems and solutions with respect to protecting units, facilities, and installations, and includes crisis management, bomb threat responses and other related topics.

This paper is concerned only with the sections of the handbook that relate to facility planning and protection, and will therefore concentrate on physical security and other planning related initiatives. While the Handbook does discuss some planning aspects, one of its weaknesses is that it does not graphically illustrate many of the concepts it discusses. Pictorial examples would probably make it much easier for personnel with non-technical backgrounds to understand. The Handbook will be rated according to its inclusion of CPTED principles at the end of this section.

Physical Security Design

In addition to the DOD Antiterrorism Handbook, the U.S. Naval Facilities Engineering Command (NAVFAC) conducts a comprehensive design training course in Security Engineering for its facilities security personnel. This course covers all levels of security and security threat including terrorism. Many elements of planning are covered in this course, although in most cases they are not specifically labeled as planning issues. In the same sense, many aspects of CPTED are also discussed, though they are not specifically labeled CPTED techniques. These CPTED related aspects will be discussed in detail at the end of this section.

The course summary, notes, and overheads, which are what this paper uses to make an evaluation, cover a number of security issues from petty theft to terrorism and attacks by environmental and nuclear activists. The threats are labeled in order of seriousness. Vehicle bombs and their effects on structures are also discussed along with vehicle barrier test reports for vehicles hitting different types of barriers at various speeds. Effectiveness of barriers, including estimated penetration times with various tools and weapons are discussed. There is a section on lighting type and efficiency, and recommendations for lighting types and levels for various areas. Interior and exterior alarm systems and system configurations are discussed in detail, as are doors and related hardware, windows, CCTV systems, and general security equipment such as safes.

The NAVFAC class reviews the design process, illustrating many individual design techniques and discussing their effectiveness. It talks a great deal about protecting individual facilities but does not stress comprehensive base planning, nor does it mention traffic calming. The course makes a case for planning by stressing the cost savings

between planned systems and retrofitting. However, there *does not* seem to be a clear link between security and planning. Although the class was originally designed for engineers and facilities personnel, the organizational flowcharts all discuss the Naval Investigative Service Command (NISCOM) which is the security branch of the Navy. While the course seems very comprehensive and includes some good information and excellent graphics, it is unlikely that this information is readily available to personnel who do not take the course.

Role of Planning

In both the DOD Antiterrorism Handbook and the Security Engineering course, working level responsibility for security is given almost exclusively to security and security personnel with almost no reference to, or mention of planning, planners and facility personnel. The planning instruction does not mention antiterrorism at all and contains only a minor mention of physical security. Given the tone of the instructions, it would seem doubtful that the security personnel and the planning and facilities personnel work together to develop comprehensive programs for facilities. This is one area in which the DOD program as a whole could be improved and it will be discussed further in the conclusion of this paper.

Role of Planning in Antiterrorism Policy

As mentioned above, the DOD Antiterrorism Handbook shows that responsibility for security and antiterrorism is given almost exclusively to security and intelligence agencies. A major part of the emphasis of the handbook is on threat analysis and

vulnerability assessment. It contains a great deal of information on how to accomplish these tasks, most of which are performed by security and intelligence personnel. While it also mentions many facility planning issues, it does not actually mention planners or facilities personnel.

The handbook does emphasize the importance of physical security systems in combating terrorism. Many of the security initiatives suggested are technical, however, non-technical concepts such as access control and barrier systems are also discussed. Types of physical barriers and other physical security systems are examined in detail.

Physical planning of individual systems is discussed several times, however it is not clear whether it is the security personnel or the planning and facilities personnel who are expected to do this. The only allusion to comprehensive facility planning is in the section on security considerations for new construction at new DOD sites. Although this section mentions planning functions such as the facility siting, layout of facilities and site selection for new facilities, interfacing with planning personnel is not actually mentioned. This makes it seem that it is the security officer's responsibility to make sure security is a consideration in planning new facilities.

The only place in the handbook where consultation with facilities personnel is mentioned is in the section on physical security for a facility. This section deals with the architectural details required to physically harden individual buildings. Here the handbook suggests contacting service civil engineering organizations in order to get additional information about materials and design of effective barriers.

Current Planning Policy

The current Navy planning instruction is the NAVFACINST 11010.44, the Shore Facilities Planning Manual, published by the Naval Facilities Engineering Command (NAVFAC). Security is mentioned only briefly in the manual and antiterrorism is not mentioned at all. This manual was last updated in 1990. There are no current plans to rewrite the instruction, although amendments and supplemental policy by separate directives have come out and are expected to continue in the future.

A supplemental instruction, the Interim Technical Guidance (ITG) for Antiterrorism, Force Protection, and Physical Security of Personnel in OCONUS Housing Facilities, was issued on March 26, 1998. Although it only officially covers new, Military Construction (MCON) housing projects, it goes into more detail about the role of facilities personnel and planners in antiterrorism than the previous instructions do. This three page document outlines some of the steps required to do a plan and includes the need for a survey done by a team of activity personnel, planners, designers, and security specialists. It also offers specific guidance on how to protect buildings from exterior explosive attacks.

As illustrated by the above guidance, planning for antiterrorism tends to be a priority mainly on MCON projects. These are large military construction projects that require congressional approval due to the high dollar amounts involved. Planning initiatives for these projects mainly deal with setback requirements based on risk analysis. However, other planning aspects, such as access control, orientation and building siting, are also mentioned as considerations. Planning for antiterrorism is not

emphasized for smaller projects or for upgrades at the present time, due in part to the perceived costs of such upgrades [2].

Other Planning Initiatives

At the present time the Navy does not offer a course or have an instruction for planners and facility personnel about antiterrorism and facility design. Although the Security Engineering Course discusses some aspects of both, it is mainly a course about general security. It does not cover how to calculate a bomb blast radius, or how to do comprehensive base planning.

Some planners at the engineering field divisions have taken classes on security and terrorism, and have worked with facilities where the security threat is particularly high and security design was actually put in place. Through these experiences they developed an understanding of the principles and have become technical "experts" in security design. These personnel now act as consultants when other planning, facility and security personnel need special assistance with security design. They do bomb blast calculations for facilities and calculate required setbacks. Some of the experts at LANTDIV have expressed an interest in additional training, and in particular in a course or manual designed specifically for planners and facility personnel on security and antiterrorism design [3].

It is interesting to note that the experts at LANTDIV had not taken the Security Engineering Course at the time this paper was written, although they were scheduled to attend in the fall of 1998. They also reported the class sponsors had requested that major facilities send both a facility person and a security person to the class. This indicates that

there does seem to be an effort to try to remedy the disconnect between planning and security personnel, although this may also have been an arbitrary decision and the disconnect may not have been specifically identified as a problem.

As mentioned above, the cover letter to the supplemental instruction, Interim Technical Guidance (ITG) for Antiterrorism, Force Protection, and Physical Security of Personnel in OCONUS Housing Facilities, also offers some guidance to facilities personnel. This letter provides some foresight into the role the Navy would eventually like its facilities personnel to play in the antiterrorism effort. The letter states that "NAVFAC's policy is to provide customers with cost effective antiterrorism and physical security systems as an integrated part of the facility planning, engineering, and design process" (NAVFAC, 1997, pg. 1).

Although the letter states that the customer is still required to provide criteria for threats, risks, vulnerability and criticality assessments of proposed projects, NAVFAC and its subordinate commands are made responsible for reviewing projects for compliance with the DOD Antiterrorism Handbook. The letter requests that NAVFAC Engineering Field Divisions (EFDs), Engineering Field Activities (EFAs) and Public Works Centers (PWCs) designate a point of contact for antiterrorism and that this person be familiar with the DOD and NAVFAC antiterrorism instructions. It also encourages antiterrorism training for planners and designers. It directs planners to ensure that antiterrorism criteria is included in activity master planning studies and tells them to assist customers in locating facilities in accordance with safe standoff distances (NAVFAC, 1997). Again, although the supplemental guidance only officially covers

new, Military Construction (MCON) housing projects, it does indicate what part facilities personnel and planners should play in antiterrorism in the future.

The Naval Facilities Engineering Service Center has a security assessment team in their Security Engineering Division which is also mentioned in the ITG cover letter. This team publishes instructions on specific aspects of physical security, such as effectiveness of windows and barriers. The assessment team also applies risk analysis methodology to provide recommendations for security improvements for military activities (Federal Facilities Council, 1997). However, they do charge for their services, so an activity would probably have to have an identifiable threat in order to be able to justify getting assistance from them.

Although there are several problems with the DOD and Navy systems, offering remedies to these problems is often easier said than done. The Department of Defense is a huge organization and as such, faces many of the conflicts inherent in an entity of its size and complexity. These difficulties and the disconnect between planning and security will be discussed further in the conclusion of this paper.

Comparison of Current Navy Policy with CPTED Principles

This section of the paper reviews and ranks the DOD Handbook O-2000.12-H and the NAVFAC Security Engineering Course according to their inclusion of CPTED principles noted in the previous chapters. This review was done in order to establish a baseline with the purpose of determining how and to what extent CPTED principles should be incorporated into Navy planning practices. The rankings, which are

summarized in Table 6.1 and Table 6.2, are based on the observations of the writer and was not determined by any formal or scientific method.

DOD Handbook 0-2000.12-H

DOD Handbook 0-2000.12-H, *Protection of DOD Personnel and Activities against Acts of Terrorism and Political Turbulence* was published in February of 1993. As mentioned in the previous chapter, the handbook delegates working level responsibility for antiterrorism almost exclusively to security personnel. While the handbook does mention facility planning issues, there is almost no reference to, or mention of planning, planners and facility personnel. The only allusion to comprehensive facility planning is in the section on security considerations for construction at new DOD sites. Planning functions such as the facility siting, layout of facilities, and site selection for new facilities are mentioned in this section. Most of the security initiatives suggested would fall under the "mechanical" designation, as noted previously. While the handbook encourages the use of technology and people -- the most costly elements in security -- the same paragraph also emphasizes that the *system should be cost-effective* (emphasis added.)

DoD Antiterrorism Handbook: Adherence to CPTED Principles					
Ranking	Poor	P-M	Moderate	M-H	High
Overall Rating based on CPTED and Planning		X			
Territoriality		X			
Surveillance			X		
Access control				X	
Activity Placement	X				
Maintenance		X			
Emphasis on Natural		X			
Use of Organized					X
Use of Mechanical					X
Comprehensive Planning		X			
Planner & Security as Team	X				

**Table 6.1: Matrix of the DOD Antiterrorism Handbooks
Adherence to CPTED Principles**

1. Territoriality

The DOD handbook included the following items that were related to the CPTED principle of territoriality:

- The use of psychological boundaries such as signs, hedges delineating property lines, and closed doors (also related to access control).
- It mentions the need to avoid the "fortress effect" look in some locations.

This reviewer gave the handbook a *poor to moderate* score for the territoriality principle because it made no mention of trying to create a sense of ownership in the facilities' users.

2. Surveillance

The DOD handbook included the following items that were related to this principle:

- Mentions clear zones and controlling vegetation so as not to block views.
- For new DOD sites, the handbook mentions that the building should be sited at the high point of a land track and that there should be a 100-foot minimum setback from the perimeter of the facility. It also mentions keeping parking away from the building.

This reviewer gave the handbook a *moderate* score for the surveillance principle because it emphasized electronic surveillance instead of natural. It also included a requirement for buildings to be conducive to grilling or eliminating all windows below 16-foot level, which is contradictory to natural surveillance.

3. Access Control

Access control was a major emphasis of the handbook, which included the following items that were related to this principle:

- Entry and circulation control, and access delay were all discussed in relationship to access control.
- Barrier systems are a major emphasis. The handbook discusses a layered system of barriers and many specific barrier types, both mechanical and natural, and their effectiveness. Some natural barriers are described in detail.

This reviewer gave the handbook a *moderate to high* score for the access control principle. While it did include many natural access control elements; it also heavily stressed mechanical and organized access control, which are costly approaches.

4. Activity Placement

The handbook included the following items that were related to this principle:

- Consideration of how contractors, vendors, and other visitors are identified, granted access to, and controlled once they enter the facility when assessing vulnerability.
- Consideration of parking locations and accessibility when assessing vulnerability.
- Notation that DOD typically erects structures that must stand for 25 to 100 years, so uses may change drastically.

This reviewer gave the handbook a *poor* score for the activity placement principle.

While it mentioned the fact that activities are likely to change and that some activities could create risk, it made no mention of using activity placement to promote natural surveillance, territoriality, and natural access control.

5. Maintenance

The handbook included the following item that was related to this principle:

- Inspection and maintenance of barrier systems and security components is mentioned.

This reviewer gave the handbook a *poor to moderate* score for the maintenance principle.

While it did not mention the psychological aspects of maintenance, the physical maintenance portion covered all systems, both mechanical and natural.

NAVFAC Security Engineering Course

As mentioned in the previous chapter, the NAVFAC Security Engineering Course does include several elements of planning in it, including the use of some initiatives based on CPTED related strategies. The course notes include a case study on CPTED

showing the cost savings if these techniques were used early in the planning and design process. The case study is the only place in which "CPTED" is actually mentioned and the specific concepts and principles of CPTED are not actually discussed.

The course has several major drawbacks. Although it mentions planning it does not go into any detail regarding comprehensive planning. It also does not discuss or encourage a partnership between facilities and security personnel. It relies more heavily on organized and mechanical security solutions than in natural solutions. Also, it is related to overall security, not specifically to terrorism. Although the course does discuss bomb blasts and terrorism as a security risk, it does not appear to discuss these in relationship to the CPTED related concepts. Note that this evaluation is based on course notes and overheads only, not attendance. Some of the principles may have been discussed in more detail in the actual course presentation; however, it should be noted that the course materials generally give one a good indication of the substance of course coverage.

NAVFAC Security Engineering Course Adherence to CPTED Principles					
Ranking	Poor	P-M	Moderate	M-H	High
Overall Rating based on CPTED and Planning			X		
Territoriality			X		
Surveillance				X	
Access control			X		
Activity Placement				X	
Maintenance	X				
Emphasis on Natural			X		
Use of Organized				X	
Use of Mechanical					X
Comprehensive Planning			X		
Planner & Security as Team		X			

**Table 6.2: Matrix of the NAVFAC Security Engineering Courses
Adherence to CPTED Principles**

1. Territoriality

The NAVFAC Security Engineering course included the following items that were related to the CPTED principle of territoriality:

- The use of personnel working in the area as part of detection resource.
- Psychological impact created by removing perceived opportunity as a basic security design technique.
- Psychological deterrence, defined as letting people know security measures have been taken without being obtrusive, through the use of signs, fences, lighting, alarms, highly visible locks, etc.

This reviewer gave the course a *moderate* score for the territoriality principle. While it does mention the use of personnel for detection, it also made no mention of trying to create a sense of ownership in the facilities users.

2. Surveillance

The course included the following items that were related to this principle:

- Goal of visibility enhancement is to make people believe they will be seen if they do something wrong.
- Achievement of goal through design and layout. Design suggestions included: putting windows in supervisors offices and in small, enclosed spaces; use of low partitions, not walls; locate reception desk for maximum viewing; use low shrubs and unbroken walls.
- Some emphasis on lighting

This reviewer gave the course a *moderate to high* score for the surveillance principle because it emphasized many natural techniques, although it also relied heavily on electronic surveillance.

3. Access Control

The course included the following items that were related to this principle:

- Controlling, channeling, and limiting access as a basic part of security design.
- Utilizing zones to control access, noting that locks cannot substitute for layout by zones; during working hours, locks impair productivity.
- Some utilization of passive barriers.

This reviewer gave the course a *moderate* score for the access control principle. While it did include many natural access control elements; it also heavily stressed mechanical and organized access control.

4. Activity Placement

The course included the following items that were related to this principle:

- It listed enhancing visibility by locating workstations to provide good visibility by and of employees and visitors as a basic security design technique.
- It mentioned the use of employees for "casual surveillance," to reduce the guard force.

This reviewer gave the course a *moderate to high* score for the activity placement principle. It mentioned using activity placement to promote natural surveillance, though not to promote territoriality, and natural access control.

5. Maintenance

The Security Engineering course did not appear to mention maintenance at all and so this reviewer gave it a *poor* rating for the maintenance principle.

In summary, the Security Engineering Course included more of CPTED principles on the whole than the Antiterrorism Handbook did. Still, as shown by the examples in the CPTED principles, there are many ideas that can be used and incorporated into target protection strategies that were not touched on in either one of the manuals. Both sources relied much more highly on the mechanical and organizational security methods, than on natural methods. Although some CPTED principles are included in these guidelines, there is definitely an opportunity to include more of the principles in DOD and Navy security planning strategies. The more natural CPTED methods also tend to be much more cost effective than mechanical and organizational methods, a definite bonus in this time of limited budget resources.

CHAPTER SEVEN CONCLUSION

Overview

This section will discuss the advantages of using CPTED in antiterrorism. Advantages include will be aesthetics, public perception, cost, and an overall increase in base security. Future opportunities will be discussed, in particular the opportunity to have security and planning work as a team. It will also discuss constraints, including the difficulties in retrofitting existing bases vs. using the techniques on new facilities. An additional constraint which will be discussed is the difficulty of large organizations to adapt to new ideas.

Advantages of using CPTED

There are many advantages to using CPTED as a method of security against terrorism. Some of the main reasons are the aesthetic advantages of using more natural approaches to security and also the cost advantages over organized and mechanical methods.

Aesthetics and Public Perception

Time and time again aesthetics and public perception are given as reasons for lack of security measures at facilities. In the case of the October 1983 bombing of the Marine barracks in Beirut, U.S. military officials argued that "erecting ... obstacles around U.S. posts in Lebanon would create a bunker appearance inappropriate to the peacekeeping role" (Beck, 1983, pg. 89). French officials agreed, even though they had recently lost almost 60 paratroopers in a similar attack.

Image is important in U.S. Embassy design, which has a goal of allowing for open diplomatic relations and calls for a welcoming atmosphere (Rosenheck, 1993, DuPont, 1996). The 1985 State Department Commission, recommended design criteria to help protect embassies against terrorism such as:

- 10-15 acre site capacity,
- 100-foot setback for all structures, and
- complex to be of separate constructions to allow for multiple barriers of penetration as an added security measure.

While these recommendations allow and encourage CPTED and other passive defense strategies, other restrictions include:

- minimum opening for fenestration and windows, comprising no more than 30% of all public facades,
- 9-foot-high perimeter wall around the complex, and
- maximum of two access gates (DuPont, 1996).

These other restrictions, while they may help improve security, tend to create an atmosphere of isolation and mistrust. After the recent embassy bombings in Africa, a U.S. businessman described the U.S. embassy in Tanzania as "a fortress," and said "I always complained to the ambassador that it left the impression Americans didn't trust Africans" (Greve, 1998). Often, fortress-like security methods isolate the diplomats and make it difficult for them to do their jobs (Kempster and Meisler, 1998).

The U.S. military is also becoming more sensitive to the value of public opinion and has been striving to improve relations with local communities. CPTED, by using a natural approach based on the placement of activity, offers a more aesthetic and less

threatening alternative to traditional security techniques. Using more aesthetic and friendly security measures may help foster cooperation and affinity with the local community. They can also improve the environment for personnel working and living on the base.

Cost

The DOD Antiterrorism Handbook stresses the importance of cost-effectiveness in designing a security system. Using CPTED strategies can have significant cost saving over traditional security techniques. Not only can the up front cost be considerably less, the long term costs are almost certain to be a substantial saving over having to pay salaries for organizational security, or having to pay for long-term maintenance and power costs for electrical/mechanical elements (Moreno, 1996, Post, 1995).

Defensive architecture expert Eve E. Hinman, in her lecture on reducing the effects of bomb blasts on structures, emphasizes that "increasing standoff is usually the most cost effective way of providing protection" (Hinman, 1997). Curt P. Betts, from the U.S. Army Corps of Engineers, Protective Design Center agrees that "application of (environmental design) principles results in more efficient, less costly solutions to very complex security problems" (Betts, 1993).

In addition to the financial cost saving, CPTED methods are also more sustainable than traditional electrical and mechanical security. Because they do not involve a continual drain on resources such as electricity, the cost to the environment of using these methods is much less.

General Increase in Security

Using CPTED techniques for antiterrorism is also likely to increase general security in other areas. CPTED was designed to reduce more common crimes such as theft, assault, etc. Studies have proved empirically that a number of these methods are indeed effective (Sherman, 1997). The process of designing CPTED strategies into a base design for antiterrorism is likely to result in a reduction in other crimes on the base as well.

Future Constraints

There are both physical and organizational constraints involved with incorporating CPTED into force protection. The physical constraints would be a problem in any area, not just on military facilities. The organizational constraints are also not limited just to the DOD organizations or the Navy in specific, they are general constraints that likely to occur in any large organization.

Retrofitting Existing Bases vs. New Facilities

Physical constraints are a concern when working with existing facilities or in a defined or limited area. It can be difficult to achieve proper setbacks for access control, and natural surveillance when working with existing structures, particularly if the structures are historic and thus cannot undergo major alterations. In these situations CPTED principles such as activity placement and territoriality may be more useful in increasing security.

Obviously there is a need to consider reasonableness in dealing with exiting facilities. The past case studies have shown a tendency for the assessors to underestimate the bomb blast size for the area. Therefore, while it is recommended to have some area around targets, the recommended 100 feet of standoff distance may not be cost effective given the changes needed to achieve it. Again, principles such as natural surveillance, territoriality and activity placement may need to be relied upon instead of access control in these cases. The solution is to "do it smarter;" imaginative and innovative designing can often overcome many physical constraints.

The Security Engineering Course points out that there is a significant cost savings if CPTED principles are incorporated into facilities at the planning stage of the facilities process as opposed to trying to incorporate them in as an "afterthought." This is one area that might be helped significantly if security personnel were more involved in the facility planning process (NAVFAC, 1991). However, in order to achieve more involvement between security and planning, some of the organizational constraints may have to be overcome.

Organizational Constraints

Several of the preceding sections mentioned an apparent disconnect between planning and security. Both the DOD Antiterrorism Handbook and the NAVFAC Security Engineering Course give responsibility for security and antiterrorism almost exclusively to security and intelligence agencies. As mentioned, while they do reference some planning issues, there is very little mention of planners and facility personnel. The

planning instruction does not mention antiterrorism at all and has only a minor mention of physical security.

The disconnect between security and planning personnel is not limited to the military. Recent surveys of police and security personnel in the civilian community show great frustration on their part about their lack of inclusion in the planning process (Schneider, 1998.) And many civilian law enforcement official complain that they have a difficult time getting architects and engineers to pay attention to CPTED initiatives (Post, 1995).

The disconnect between departments is also not specifically a Navy and DOD problem. The Department of Defense is a huge organization and, as such, faces many of the conflicts inherent in an entity of its size and complexity. In general, the tendency of large organizations to compartmentalize is common. In many large organizations, specific departments become territorial and do not want to share ideas with "other" departments. Also, the larger an organization is, the more specialized its individual parts tend to be. Both the size and the territoriality in an organization tend to make open communication between the departments difficult to achieve (Hunt, 1972).

Other problems that may affect the incorporation of CPTED into Navy force protection include the natural conservatism of large organizations and the difficulty they have in innovating. Large organizations change slowly. There also tends to be time lapses between an event (an increase in terrorist activity, for example) and the solutions put in place to change the event. While there are problems with the DOD and Navy organizational systems, offering remedies to these problems is often easier said than done. It may be easier to incorporate solutions on a smaller, facility specific scale than to

affect policy in general. The JIATF-EAST case presented in Chapter 5 is an excellent example of this principle.

Future Opportunities

There are several opportunities to improve future CPTED and antiterrorism efforts in general. One important opportunity is the new version of the DOD 2000.12H handbook, which is due out this year. The handbook will be changed to a DOD Directive rather than a handbook; and as a directive it will carry more weight. Although it is not anticipated that the new directive will have more CPTED elements, this additional emphasis on antiterrorism will provide military facilities with the opportunity to receive added consideration for antiterrorism initiatives.

Security and Planning as a Team

There is a great opportunity, particularly in the Navy, for planning and security personnel to work together. Experts such as Oscar Newman stress that "this kind of planning goes awry when law enforcement tries it by itself" (Post, 1995, pg. 19). Because Navy facilities, planning and security personnel are all part of one organization, they may be more successful in selling the idea of a joint planning/security partnership than their civilian counterparts. Security courses and the DOD Handbook discuss antiterrorism concepts, but it requires both planning and security personnel in order to provide all of the knowledge and experience needed to put a *comprehensive* plan together.

Another opportunity available is the cultivation and use of people from the community to help increase security. The Khobar Towers case contains an example where a civilian policeman took the initiative to call a tow truck to remove the truck containing the bomb. Unfortunately the call was not in time to help the situation. However, the incident is insightful in that it shows that members of the outside community can be helpful in observing and reporting suspicious happens around a facility.

Getting the support of the base Commanding Officer (CO) and other influential personnel is important in the implementation phase of any project. Many base CO's have great personal attachment and pride in the facility they are in charge of. This includes an interest in the actual appearance of the facility. The aesthetic alternative to security that CPTED provides can be a very popular concept in that it is both cost effective and provides a pleasing appearance.

Summary

Experts agree that CPTED methods, such as setbacks, access control, and good surveillance are some of the best ways to reduce the effect of a terrorist bombing (Hinman, 1995). Both mechanical and organizational methods have their drawbacks. The basic components of organizational security are human, and, as seen in past terrorist attacks, they may not be as effective if they do not feel a personal stake in the territory they are protecting.

Electrical and mechanical equipment can fail due to problems with power sources, lack of maintenance, or for many other reasons. They can also be relied on too heavily.

Terrorist experts warn that: "Overreliance on technology often produces mental sloppiness, complacency, and – what may be the greatest threat to counterterrorist strike forces – overconfidence. ...Under some circumstance, high-technology armaments and equipment may even be counterproductive." (Livingstone, 1982, pg.198).

The use of CPTED for antiterrorism is a relatively new concept. Several articles contemplated whether the use of CPTED techniques would have helped avert the Oklahoma City tragedy (Post, 1995; Moreno, 1996). However, if the issue of having appropriate set-backs is disregarded, there are very few sources that specifically link CPTED methods to antiterrorism.

While in some ways terrorism is a different kind of crime than that which CPTED was designed to help prevent, in other ways it is very similar. CPTED has been relatively successful in the originally intended use, so, in theory it should also help discourage terrorism (Moreno, 1996). As history has demonstrated and as modern security experts recommend, security should be done as a layered approach. CPTED is an additional layer (conceptually or physically), and one that could be very valuable from the standpoint of both the security of the complex, and the creation of a better environment in which people can live and work.

APPENDIX A
JIATF-EAST PROJECT BLAST ANALYSIS



JIATF EAST PROJECT

BLAST ANALYSIS

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The formula used for relating safe distance to both overpressure and fragmentation damage is given by:

$$D = KW^{1/3}$$

Where:

D is the distance (or radius) in feet from the point of detonation that an overpressure in psi is measured,

W is the weight of the explosive in pounds of TNT,

K is a numerical conversion factor which relates the pressure (in psi) to the distance **D**.

The relationship between **K** and the overpressure in psi is given in Table F-3 where **K** is given in $\text{feet}/(\text{lb})^{1/3}$.

This equation can be used to determine the distance at which a certain pressure is experienced if a weight of explosives equivalent to **W** pounds of TNT is used. From Table F-1 we can determine the amount of damage that occurs to different structures from this overpressure. If the explosive is not TNT, then a conversion factor has to be used to determine the equivalent amount of TNT.

Example

Car Bomb made of 1000 kg of Ammonium Nitrate / Fuel Oil (ANFO).
In English units: 2,205 lbs of ANFO.

1 lb of ANFO = .83 lbs of TNT

2,205 lbs x .83 = 1,830 lbs TNT

$$D = KW^{1/3}$$

For an overpressure of 3 psi which could cause severe damage to the JIATF East buildings and injuries to personnel cause by fragments and debris:

$K = 20 \text{ ft/(lb)}^{1/3}$ (from table F-3)

$W = 1,830 \text{ lbs}$

$$D = (20) \times (1,830)^{1/3}$$

$D = 245 \text{ ft}$

1 psi $D = 554'$

7 psi $D = 160'$

NOTES

Safe Blast (Overpressure) Distance

The K-factor of 300 has been established for determining the safe-blast distance. This K-factor converts to a 0.007 psi value, the lowest level of damage caused by blast overpressure.

Safe Frag Distance

The K-factor of 300 for light case munition and 500 for heavy case munition has been established for determining the safe-frag distance. This K-factor converts to a fragment velocity at which most fragments are traveling too slow to penetrate unprotected human skin.

Table F-3. K Factors

Explosion Effect		K Factor
Hazardous Fragmentation		300.0'
		500.0'
Blast Overpressure		
PSI	kPa	
0.07	0.48	300.0
0.10	0.69	250.0
0.50	3.45	75.0
1.00	6.90	45.0
2.00	13.79	30.0
3.00	20.69	20.0
4.00	27.58	18.0
5.00	34.48	15.0
6.00	41.37	14.0
7.00	48.27	13.0
8.00	55.16	12.0
9.00	62.06	11.0
10.00	68.95	10.0
15.00	103.43	8.0
20.00	137.90	7.0
30.00	206.85	6.0
40.00	275.80	5.0
60.00	413.70	4.0
100.00	689.50	3.5
200.00	1,379.50	3.0

EXTRACT FROM NAVY EODB/ARMY TM/AIR FORCE TO 60A-1-1-1

(Revision 2)

- Light
- Heavy case

EXTRACTED FROM NAVY EODB/ARMY TM/AIR FORCE TO 60A-1-1-4
(Revision 2)

Table F-1. Blast Overpressure Effects

Target Element	Damage	Blast Overpressure
		PSI
Aircraft	Control surface or other minor damage	1.0 - 2.0
	Major repair	2.0 - 3.0
	Complete	4 - 10
Glass windows, large and small	Shattering, occasional frame failure ¹	0.5 - 1.0
	Severe frame failure ¹	1.5 - 3.0
Wood frame structures	Roof rafter cracked	0.5 - 1.5
	Studs and sheathing cracked	1.0 - 3.0
	Collapse	Over 5.0
Metal (Butler type) buildings	Corrugated aluminum/steel paneling moderately buckled/joints separated	0.5 - 1.0
	Severe buckling/some panels torn off	1.0 - 2.0
	Complete destruction of siding/interior destroyed ²	Over 3.0
Concrete block or brick wall, 8 - 12 inches (unreinforced)	Severe damage/shattering	1.0 - 2.0 ³
	Collapse	7.0 - 8.0
Corrugated asbestos siding	Shattering	1.0 - 2.0
Reinforced concrete walls	Moderate cracking	3.0 - 4.0
	Severe spalling/wall displacement	6.0 - 8.0
	Concrete shatters, bare steel remains	10 - 14
	Complete destruction	14 - 20
Liquid storage tanks:(unpressurized)	Slight damage	0.5 - 1.5
	Severe damage	3.0 - 4.0
	Collapse	8 - 10
Vehicles/trailers	Complete destruction	10 - 14
Heavy machinery (generators, compressors, etc.)	Moderate damage	6 - 8
	Complete displacement	8 - 10
	Destruction	14 - 20
Steel towers	Blown down	30 ⁴
Personnel	Temporary threshold ear damage	0.2 ⁵

Footnotes to table F-1

1. Frame failure will not occur if glass is thin and breaks easily.
2. Frame failure may occur if siding has been reinforced or strengthened.
3. For reinforced walls or those built between rigid supports, pressures of 3.0 - 4.0 psi are needed for damage/shattering.
4. Where explosive quantities are large, lesser pressures may destroy towers.
5. Temporary threshold ear damage may cause temporary loss of hearing depending on peak impulse pressure, speed, and other factors.

EXTRACTED FROM NAVY EODB/ARMY TM/AIR FORCE TO 60A-1-1-4

(Revision 2)

APPENDIX B
JIATF-EAST CASE STUDY

JIATF-EAST DESIGN OPTION ONE

Some of the unique aspects of design option 1 (located in the insert section at the back of this section) and the CPTED principles they illustrate included:

Territoriality

- Improved signage throughout the facility (included in all design options).

Surveillance

- Integration of lighting and CCTV into the design around the core buildings.

Access Control

- The use of the concrete based flagpoles as vehicle stops in front of the main entrance.
- Developing secure parking areas (also Territoriality)
- Regulating the secured parking through use of gates and proximity card readers.
- Eliminating the road to the north of the core buildings.
- Using boulders and palm trees as vehicle stops in the landscaping scheme around the athletic field.
- Redirecting the truck access to the proposed loading dock on building 1279 and relocated the dumpsters.

Activity Placement

- The addition of an external covered walkway to offer a secure solution to internal employee/document circulation within the fence line that included entrances to all four buildings. A secondary route through interiors of 291, 290, 289 and 1279 was also provided. (This is also an example of territoriality, access control, and surveillance.)
- The redesigned athletic field, which included open space to include active recreation such as football and other sport activities and integrated a landscaped jogging path around the athletic field. (This is also an example of territoriality and surveillance.)

Maintenance

- Increased landscaping.
- Redesigning the main entrance to the core buildings to include a ceremonial drive for V.I.P. visits and redesigning the walkways and planters in front of Building 291 (this is also an example of territoriality).

Comments and critiques on this design included a concern about truck access to the loading dock on the north side of building 1279, and a concern about the location of the dumpsters near the loading dock with respect to use by the service personnel. The design did not address the Seminole Battery. There was a comment that more overhead barrier were needed, so truck turnaround access would not be cut off. An idea surfaced to place the dumpsters and loading dock outside of the compound, but it was later decided

to be impractical. The military personnel liked the athletic field and track in this option,
and also liked the landscaping design in general.

DESIGN OPTION #1

CONCEPT STATEMENT:

TO PROVIDE AN IMPLEMENTABLE AND PRACTICAL SOLUTION THAT
WILL INCREASE JIATFE SECURITY AGAINST TRUCK BOMB ATTACKS WHILE
IMPROVING THE OVERALL AESTHETIC QUALITY OF THE FACILITY.

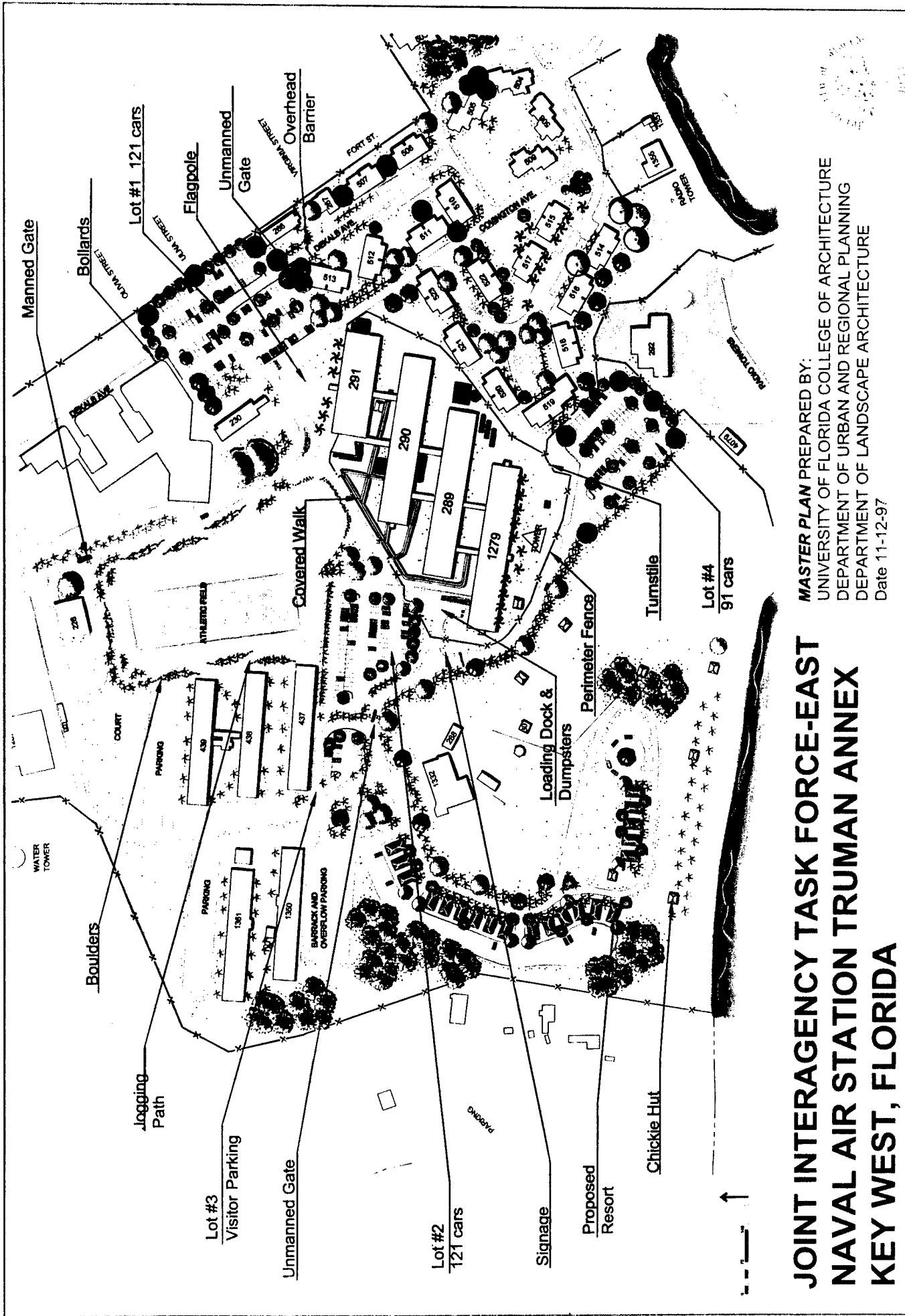
GOALS AND OBJECTIVES:

- ESTABLISH PERIMETER SECURITY TO CORE BUILDINGS 291, 290, 289, AND 1279.
 - Integration of CCTV and proper lighting to overall design.
 - Implementation of secure and continuous fence around core buildings.
- REDESIGN VEHICULAR AND PEDESTRIAN CIRCULATION AFFECTING JIATFE.
 - Create new entryways for both circulation types.
 - Redirect truck access to proposed loading dock and new dumpster location.
 - Improve signage throughout JIATFE area to inform all users of building and resort locations, traffic direction, etc.
- DEVELOP SECURE AND EFFICIENT PARKING AREAS.
 - Provide approximately 350 parking spaces for JIATFE employees, future employees, and visitors.
 - Regulate secured parking through use of gates and proximity card readers.
- OFFER A SECURE SOLUTION TO INTERNAL EMPLOYEE/DOCUMENT CIRCULATION.
 - Provide covered walk within fence line with entrances to all four buildings.
 - Provide a secondary route through Interiors of 291, 290, 289, and 1279.
- PROVIDE A DEFINED INTERFACE BETWEEN B.R.A.C. AND BASE PROPERTY.
 - Use of road entrances, fence lines, and tree lines to define military vs. city property.
- AESTHETICALLY ENHANCE MAIN ENTRANCE OF CORE BUILDINGS.
 - Design a ceremonial drive for V.I.P. visits.
 - Redesign walks and planters in front of Building 291.
- REDEFINE AND UTILIZE THE ATHLETIC FIELD'S OPEN SPACE.
 - Include recreations such as football and other sport activities.
 - Integrate a jogging path around athletic field as part of a security strategy.

JOINT INTERAGENCY TASK FORCE-EAST NAVAL AIR STATION TRUMAN ANNEX KEY WEST, FLORIDA

GOALS AND OBJECTIVES PREPARED BY:
UNIVERSITY OF FLORIDA COLLEGE OF ARCHITECTURE
DEPARTMENT OF URBAN AND REGIONAL PLANNING
DEPARTMENT OF LANDSCAPE ARCHITECTURE
Date 11-12-97



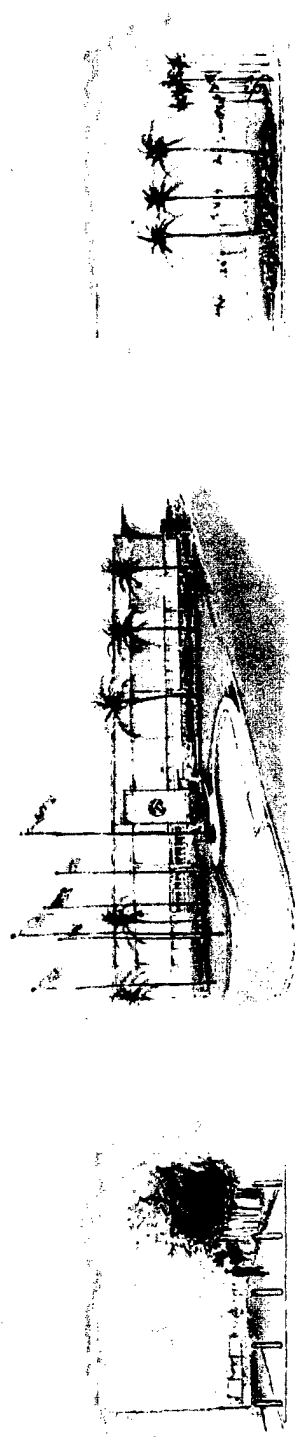
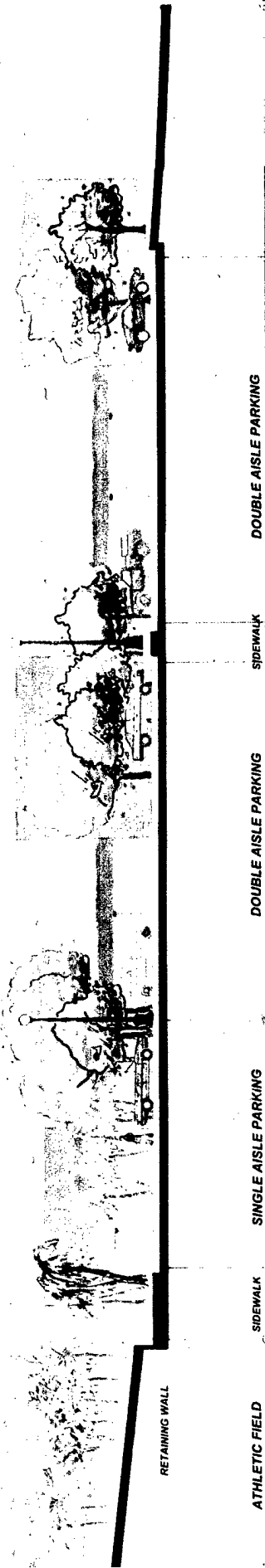


JOINT INTERAGENCY TASK FORCE-EAST **NAVAL AIR STATION TRUMAN ANNEX** **KEY WEST, FLORIDA**

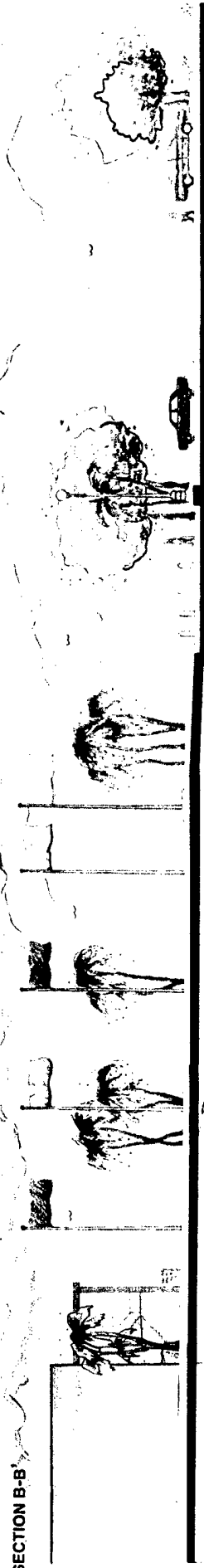
MASTER PLAN PREPARED BY:
 UNIVERSITY OF FLORIDA COLLEGE OF ARCHITECTURE
 DEPARTMENT OF URBAN AND REGIONAL PLANNING
 DEPARTMENT OF LANDSCAPE ARCHITECTURE
 Date 11-12-97



SECTION A-A'



SECTION B-B'



BUILDING 291

ENTRY WALK

BOLLARDS

MEDIAN

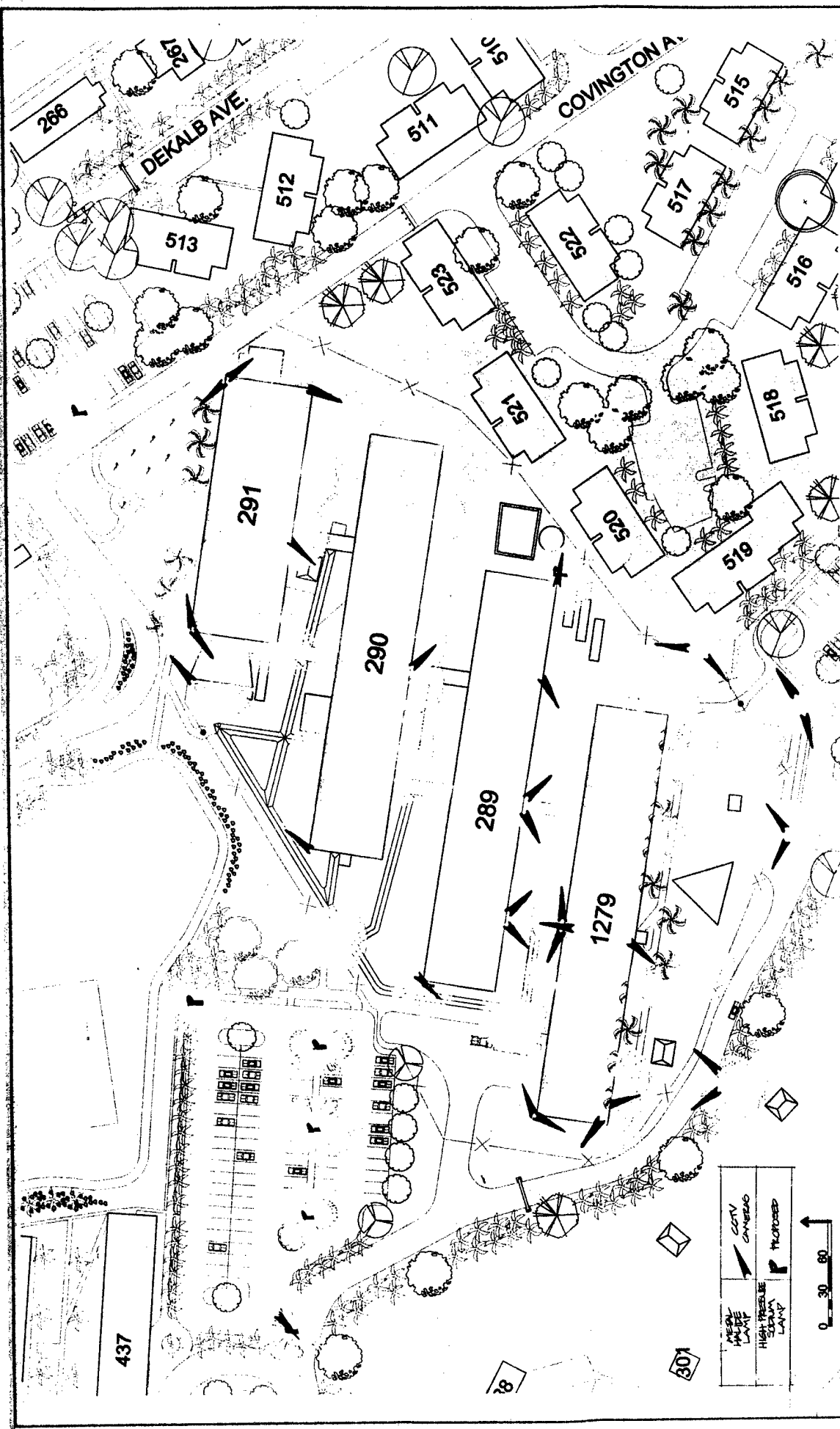
DOUBLE AISLE PARKING

MEDIAN

JOINT INTERAGENCY TASK FORCE-EAST NAVAL AIR STATION TRUMAN ANNEX KEY WEST, FLORIDA

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JOINT INTERAGENCY TASK FORCE-EAST

NAVAL AIR STATION TRUMAN ANNEX

KEY WEST, FLORIDA

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 DEPARTMENT OF LANDSCAPE ARCHITECTURE
 Date 11-12-97



JIATF-EAST DESIGN OPTION TWO

Highlights of design option two (located in the insert section at the back of this section), and the CPTED principles they illustrate included:

Territoriality

- Improved signage throughout the facility (included in all design options).

Access Control

- The realignment of the main entrance roads to a curvilinear orientation and the installation of a series of roundabout drop-offs to reduce approach speeds into the complex.
- Developing secure parking areas (also Territoriality)
- Regulating the secured parking through use of gates and proximity card readers.
- Eliminating the road to the north of the core buildings.
- The restricting of delivery truck traffic to Southard Street
- The closing of Covington Street to vehicular through traffic.
- The segregation of the main parking area through the use of bollards.
- The use of a berm system to separate the parking from the buildings and to block vehicle access.

- The redirection of the truck access to the proposed loading dock on building 1279 and relocation of the dumpsters.

Activity Placement

- The canopied walkway to the northwest side of the complex to offer a secure solution to internal employee/document circulation within the fence line. (This is also an example of territoriality, access control, and surveillance.)

Maintenance

- Increased landscaping.
- The clustering of the resort housing to minimize environmental impact to the beach.
- The creation of a covered ceremonial drive for dignitaries (this is also an example of territoriality).

Comments and critiques on this design from the JIATF-EAST representatives included concerns about the United Street entrance. They didn't think access by Truman St. was possible (1st St. too narrow) so they mentioned having to use access through Southard. There were also questions about ways to prevent direct access to the building by speeding cars, even though the road was curved. The military personnel liked the berms adjacent to the parking, but as cost was a big factor, they did not think earth moving would be practical. They liked the secure parking located next to the unsecured parking, and the covered VIP entrance/drop-off.

DESIGN OPTION #2 CONCEPT STATEMENT

This concept design increases defensible space while simultaneously improving aesthetic and experiential quality.

Goals and Objectives:

Concentrating security efforts by:

- Eliminating unauthorized vehicle access within blast zone by installing access gates with proximity card readers integrated with CCTV and intercom link.

- Realigning main entrance roads for a curvilinear orientation and installing a series of roundabout drop-offs to reduce approach speeds into the complex.

- Restricting delivery truck traffic to Southard St.

- Installing clear signage and plant material throughout the complex to orient vehicular and pedestrian circulation.

- Closing Covington St. to vehicular through traffic.

- Segregating the main parking area through the use of bollards.

Increasing aesthetic, experiential and ecological quality by:

- Creating a ceremonial entrance for dignitaries and top officials.

- Adding a canopied walkway to the west side of the complex to a transition that successfully integrates the architecture with the landscape.

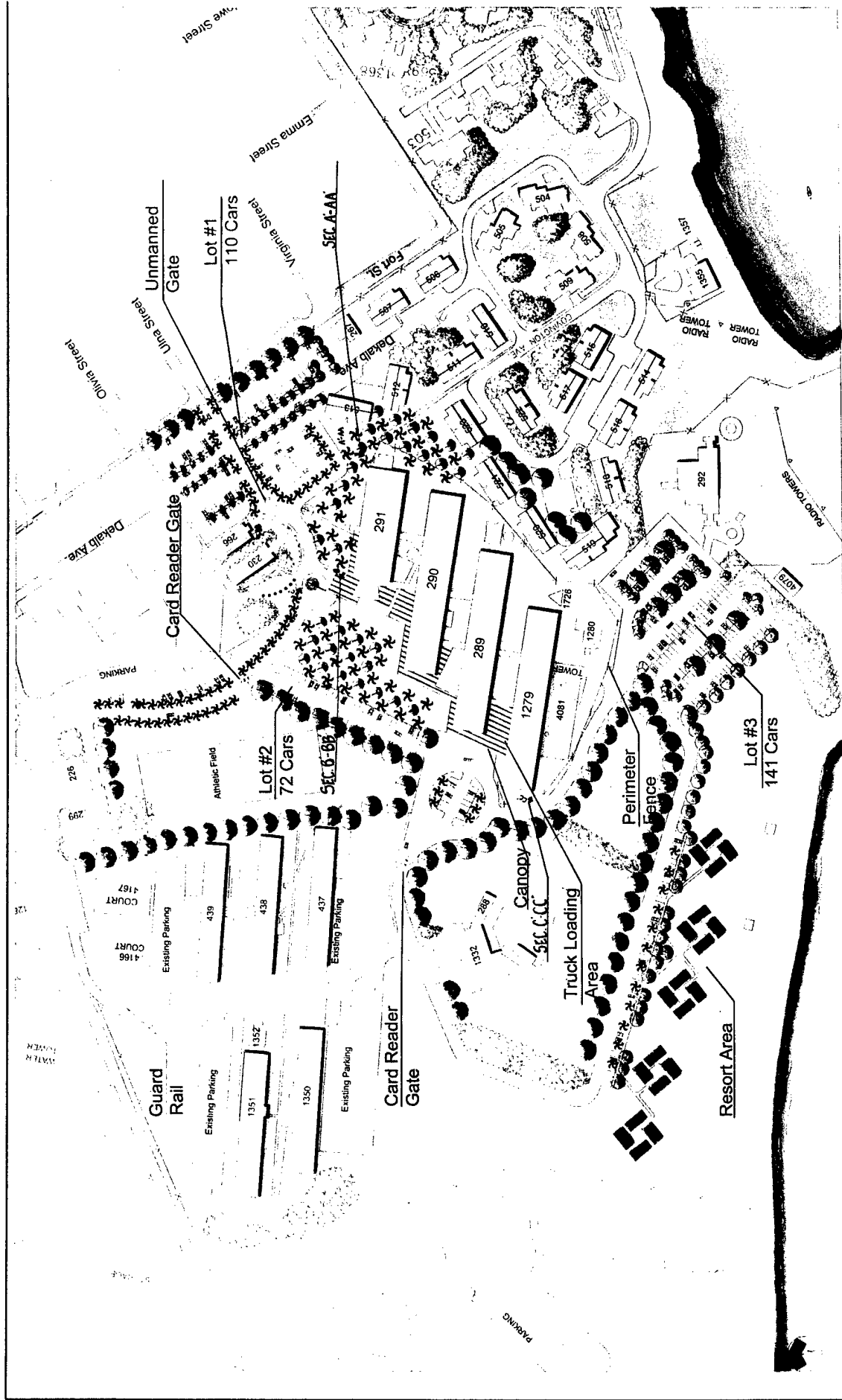
- Planting native vegetation along the buildings, parking areas and streets for microclimate control and ecological habitat.

- Clustering resort housing to minimize impact to the beach.

**JOINT INTERAGENCY TASK FORCE-EAST
NAVAL AIR STATION TRUMAN ANNEX
KEY WEST, FLORIDA**

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DEPARTMENT OF LANDSCAPE ARCHITECTURE
DATE 11-12-97

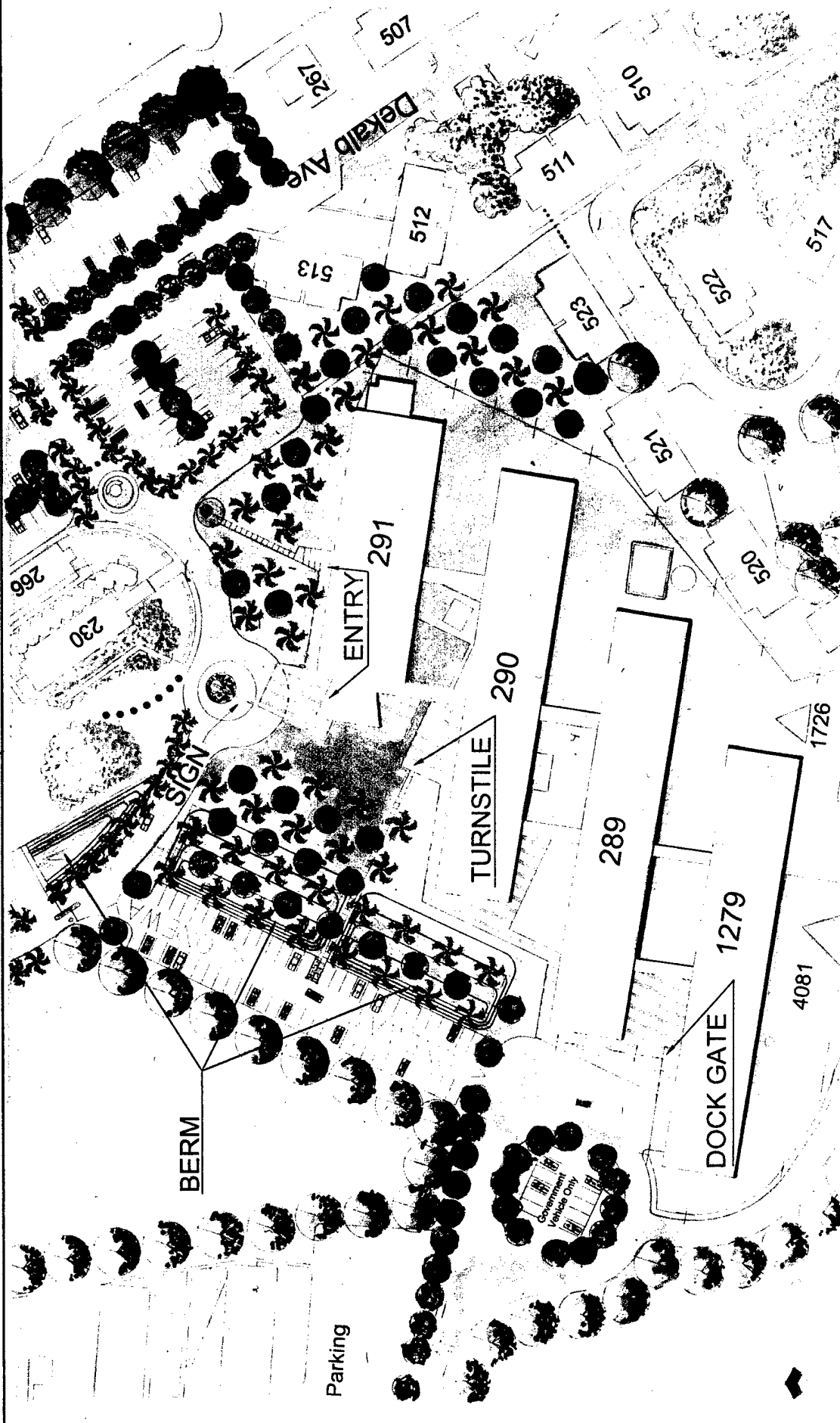




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 Date 11.12.97





JOINT INTERAGENCY TASK FORCE-EAST NAVAL AIR STATION TRUMAN ANNEX KEY WEST, FLORIDA

PREPARED BY:
 UNIVERSITY OF FLORIDA COLLEGE OF ARCHITECTURE
 DEPARTMENT OF URBAN AND REGIONAL PLANNING
 DEPARTMENT OF LANDSCAPE ARCHITECTURE
 Date 11.12.97



JIATF-EAST DESIGN OPTION THREE

The main aspects of design option 3 (located in the insert section at the back of this section) and the CPTED principles they illustrate included:

Territoriality

- Improved signage throughout the facility (included in all design options)
- Creating “zones” by cutting off the housing area from the rest of base, and by separating the resort area from the work area.

Access Control

- Using a retaining wall system to separate the parking from the building and to keep cars from approaching the building.
- Regulating the secured parking through use of gates and proximity card readers.
- Making all parking areas inside the 3,000 psi zone controlled high security level parking and controlling access on the roads inside the 3,000 psi zone (also Territoriality).
- Adding several new lots for additional parking including a new parking lot where building 266 is now located.
- Eliminating the road to the north of the core buildings.

- Creating a new Southard Street entrance to accommodate proposed BRAC plan
- Redirecting the truck access to the proposed loading dock on building 1279 and relocating the dumpsters.

Activity Placement

- Providing a secured walkway for pedestrian traffic to the southeast side of the JIATF complex. (This is also an example of territoriality, access control, and surveillance.)

Maintenance

- Increased landscaping.
- Utilizing steel-fabricated fencing instead of chain link around the entrance.
- Creating a formal entrance for VIP visits that includes the use of ceremonial fountains (this is also an example of territoriality).

The military personnel liked the idea of splitting the compound into zones with access to the work areas. Some of the personnel also liked the exterior covered walkway on the east side of buildings between the complex and the housing area.

DESIGN OPTION #3

CONCEPT STATEMENT: To design improved vehicular and pedestrian circulation and parking. Ensuring that a sensitive government facility is better protected against vehicular bomb attacks.

GOALS AND OBJECTIVES:

INCREASE SECURITY:

Make all parking areas inside the 3,000 psi zone controlled high security level parking.

Make To control access on roads inside the 3,000 psi zone

Fortify and harden JIATF compound by completely enclosing it with security fencing

Discourage unwanted pedestrian and vehicular traffic around the compound through the use of directional signs and circulation design

Control truck access into the 3,000 psi zone by placement of bollards, boulders, plant material, and other design elements

MAXIMIZE PARKING AND IMPROVE CIRCULATION:

Create new Southard Street entrance to accommodate proposed B.R.A.C. plan.

Remove Building 266 and use land for J.I.A.T.F.E. parking.

Increase parking lot size south of Building 1279 and add new parking lot to west side of 1279.

Add parking lot to the west of Building 289.

INCREASE THE AESTHETIC QUALITY OF THE JIATF COMPOUND:

Remove and reuse existing excess fencing.

Utilize steel-fabricated fencing instead of chain link fencing around entrance.

Provide a securedwalkway for pedestrian traffic within the JIATF fenced area.

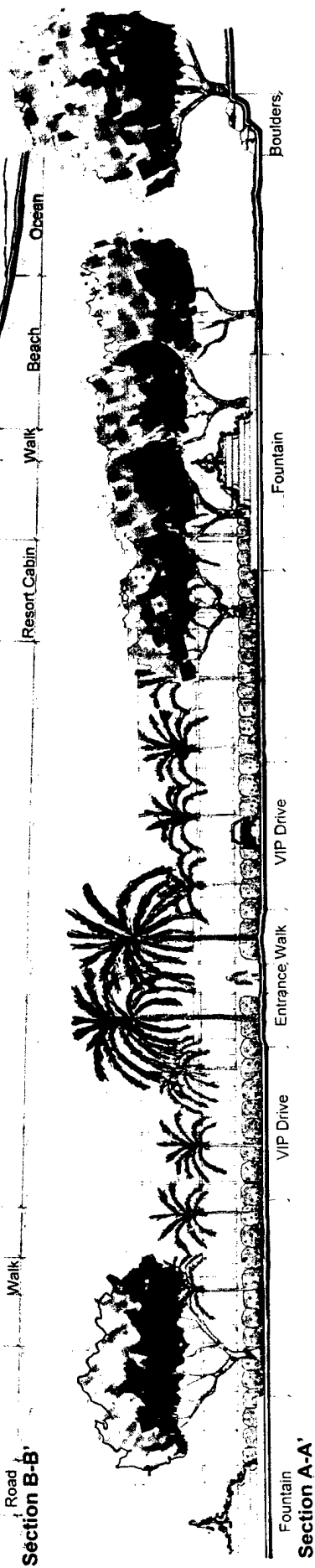
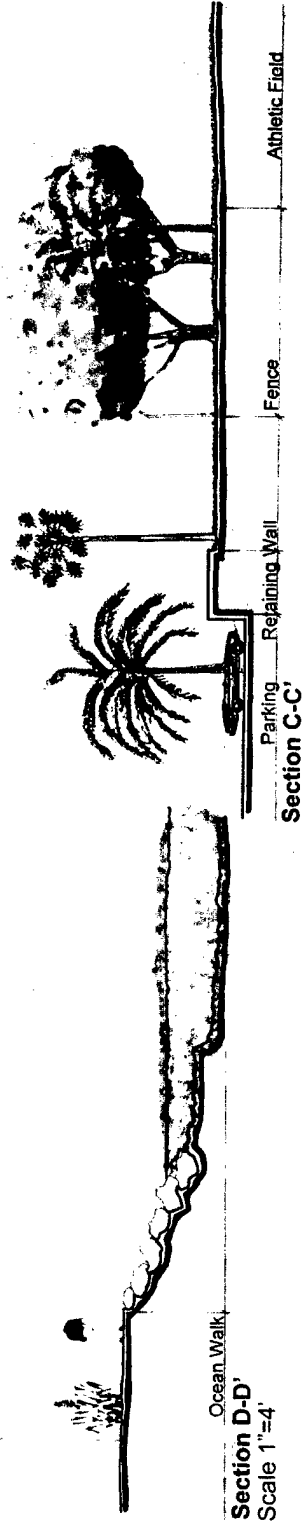
Create a ceremonial entrance for VIP visits and to create a sense of arrival.

Utilize plant material to help blend the buildings to it's surroundings without compromising security

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DATE 11-12-97





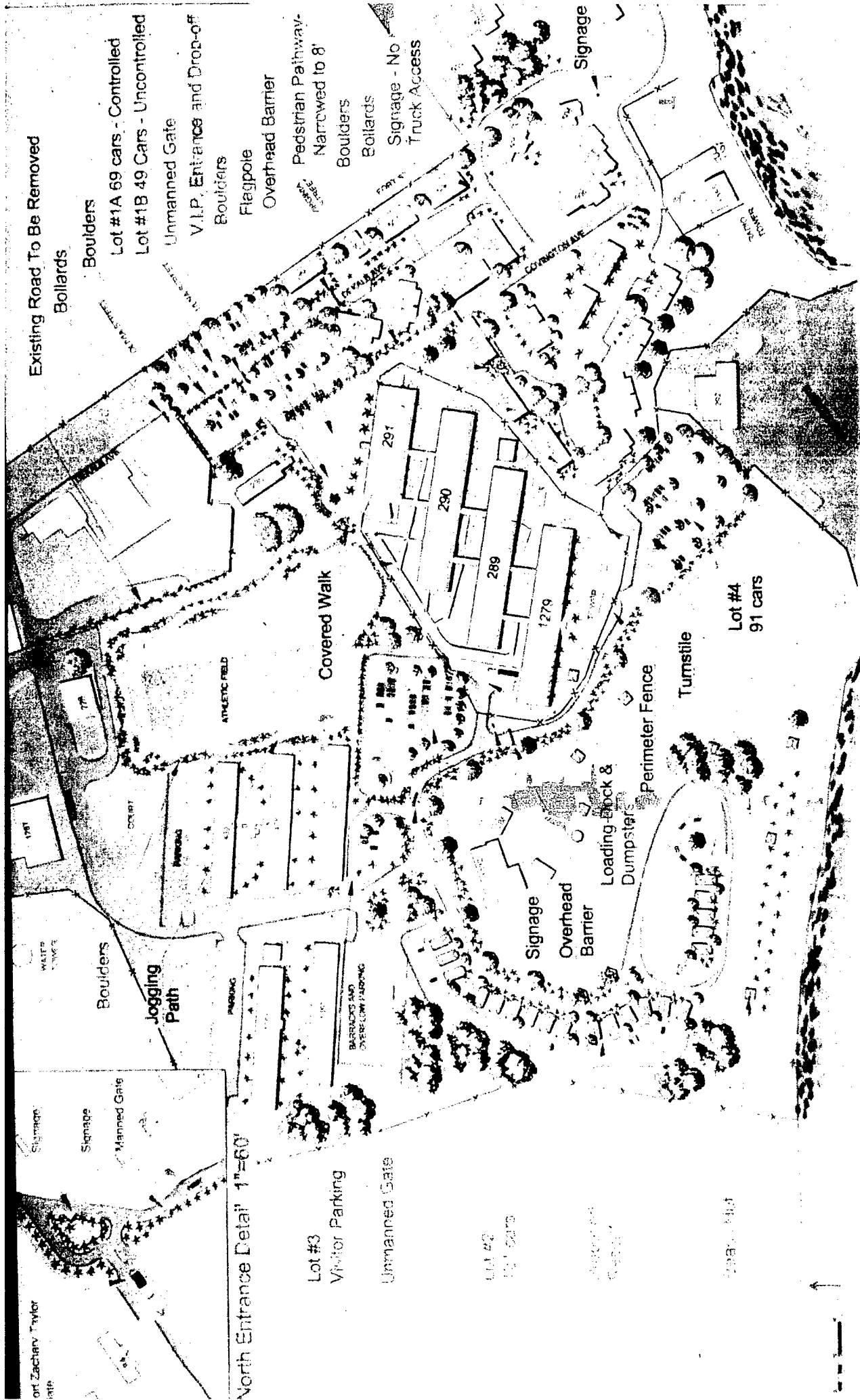
JOINT INTERAGENCY TASK FORCE-EAST NAVAL AIR STATION TRUMAN ANNEX KEY WEST, FLORIDA

Section Elevations Scale 1"=8' 5' 10' 20' 40'

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Date 10-27-97



**JATF-EAST
FINAL DESIGN**



JOINT INTERAGENCY TASK FORCE-EAST NAVAL AIR STATION TRUMAN ANNEX KEY WEST, FLORIDA

MASTER PLAN PREPARED BY:
UNIVERSITY OF FLORIDA COLLEGE OF ARCHITECTURE
DEPARTMENT OF URBAN AND REGIONAL PLANNING
DEPARTMENT OF LANDSCAPE ARCHITECTURE
Date 05.11.98

APPENDIX C LIST OF ACRONYMS

CO – Commanding Officer

CPTED – Crime Prevention Through Environmental Design

DOD – Department of Defense

DOS – Department of State

EFA – Engineering Field Activity

EFD – Engineering Field Division

FBI – Federal Bureau of Investigation

ITG – Interim Technical Guidance

JIATF-EAST – Joint Interagency Task Force East

LANTDIV – Atlantic Division, Naval Facilities Engineering Command

MCON – Military Construction

MWR – Moral, Welfare and Recreation Association

NAS – Naval Air Station

NAVFAC – Naval Facilities Engineering Command

PWC – Navy Public Work Center

QOL – Quality of Life

END NOTES

1. Quote taken from the Proteus Security Group web site, [www.http://anti-terrorism.com](http://anti-terrorism.com), ECSI International, Copyright 1997.
2. Phone interview with Diane Tucker, Architect/Facilities Planner, Commander, Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA, September 18, 1998
3. Phone interview with Brian Barstow, Facilities Planner, Commander, Atlantic Division, Naval Facilities Engineering Command, Norfolk, VA, September 18, 1998

REFERENCES

- Alexander, Ernest R., Approaches to Planning, Gordon and Breach Science Publishers, Philadelphia, PA, 1992.
- The Associated Press, "Answers sought in bombings," The Gainesville Sun, Aug. 9, 1998, p. 1A.
- The Associated Press, "Too close to street, Nairobi facility violated standards," The Gainesville Sun, Aug. 9, 1998, p. 8A.
- Atlas, Randall I., "Designing Against Terror, Design Against Crime," Designing Proceedings: Building Security Conference, Nov. 17, 1995.
- Mlakar Sr., Paul F., Corley, W. Gene, Sozen, Mete A., and Thornton, Charles H., "The Oklahoma City Bombing," Journal of Performance of Constructed Facilities, August 1998, 12, pp. 113-123.
- Banta, Kenneth W., "Visibility vs. Vulnerability," Time, 122, Nov. 7, 1983, p. 39.
- Barstowe, Brian, JIATFE Project Blast Analysis, (Unclassified Report) Naval Facilities Engineering Command, Norfolk, Va. February 1997.
- Beck, Melinda, "Inquest on a Massacre," Newsweek, 102, Nov. 7, 1983, pp. 85-89.
- Beck, Melinda, "The Rescue," Newsweek, May 1, 1995, pp. 44-45.
- Betts, Curt P., "Mitigation Terrorist Attacks Through Environmental Design," Special Security Situations, December, 10, 1993, pp. 78-83.
- Bolz, Frank, Dudonis, Kenneth J. and Schulz, David P., The Counter-Terrorism Handbook, Tactics, Procedures, and Techniques, Elsevier Science Publishing Co., Inc., New York, 1990.
- Branch, Melville C., Comprehensive Planning for the 21st Century, Praeger Publishers, Westport, CT, 1998.
- Cooperman, Alan, "Terror Strikes Again," U.S. News & World Report, 125, Aug. 17/Aug. 24, 1998, pp. 10-13.
- Crowe, Timothy D., Crime Prevention Through Environmental Design, National Crime Prevention Institute – Butterworth Heinemann, Boston, 1991.

Department of Defense, DoD Handbook 0-2000.12-H, Protection of DoD Personnel and Activities Against Acts of Terrorism and Political Turbulence, Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict, Washington, D.C., Feb. 1993.

Department of the Navy, Naval Facilities Engineering Command (NAVFAC), Interim Technical Guidance (ITG) for Antiterrorism, Force Protection, and Physical Security of Personnel in Military Housing Facilities, NAVFAC Criteria Office, Norfolk, Virginia, Mar. 26, 1997.

Department of the Navy, Naval Facilities Engineering Command (NAVFAC), "Notes & Overheads," Security Engineering Design Training Course, Naval Facilities Engineering Service Center, Port Hueneme, California, 1991.

Department of the Navy, Naval Facilities Engineering Command, NAVFACINST 11010.44E, Shore Facilities Planning Manual, Alexandria, Virginia, Oct. 1, 1990.

Dickey, Christopher, "Target: America," Newsweek, 128, Jul. 8, 1996, pp. 22-26.

"Introduction & Challenge: U.S. Embassy Complex Restrictions," Competition Criteria: The DuPont Benedictus Awards, 1996/1997, <http://cad9.cadlab.umanitoba.ca/acsa/96-97duPont/title.html>, DuPont and the Association of Collegiate Schools of Architecture, 1996.

Federal Facilities Council, Standing Committee on Research, Innovations in Federal Facilities, Technical Report #135, Washington, D.C., National Academy Press, 1997, pp. 36-37.

Greve, Frank, "Security in Africa was not a priority," The Tallahassee Democrat, Aug. 8, 1998, p. 1A.

Hinman, Eve E., "Defensive Architecture Techniques," Lecture Overheads, Hinman Consulting Engineers, Inc., Sep. 10, 1997.

Hinman, Eve E., "Designing Blast Resistant buildings: Lessons Learned from Oklahoma City – Ground Zero," Security Management, Oct. 1995, p. 26-31.

Hunt, John W., The Restless Organisation, John Wiley & Sons Australasia Pty Ltd, Sydney, Australia, 1972.

Jehl, Douglas, "How the U.S. Missteps and Delay Opened door to Saudi Blast," The New York Times, Jul. 7, 1996, p. 1.

Kempster, Norman, and Meisler, Stanley, "Secure embassies protect diplomats but make their jobs harder," San Jose Mercury News-
<http://forums.mercurycenter.com/world/embassy/0808h.htm>, Mercury Center, Oct. 9, 1998.

Kitfield, James, "Saudi Blast Still Rocks the Air Force," National Journal, 29, Jan. 4, 1997, pp. 26-27.

Kostof, Spiro, The City Assembled, The Element of Urban Form Through History, Little, Brown and Company, Boston, MA, 1992.

Livingstone, Neil C., The War Against Terrorism, D.C Heath and Company, Lexington, MA, 1982.

Lynch, Kevin, A Theory of Good City Form, The MIT Press, Cambridge, MA, 1981.

McKinley Jr., James C., "Terrorists target U.S. embassies," The Tallahassee Democrat, Aug. 8, 1998, p. 1A.

Moreno, Elena M., "Coping With Threats From Bombs to Break-Ins," Architectural Record, Mar. 1996, pp. 44-45, 111.

Mumford, Lewis, The City in History, Secker and Warburg, London, 1961.

National Research Council, Committee on Feasibility of Applying Blast-Mitigation Technologies and Design Methodologies from Military Facilities to Civilian Buildings, Protecting Buildings From Bomb Damage, National Academy Press, Washington, D.C., 1995.

Nadis, Steve, "Bomb Stoppers," Popular Science, 288, Jan. 1996, pp. 58-59.

Newman, Oscar, Crime Prevention Through Urban Design, Defensible Space, The Macmillan Company, New York, 1972.

Newman, Oscar, Design Guidelines for Creating Defensible Space, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., 1975.

Post, Nadine M., "Special Report on Defensible Space: More Than Merely Cops and Robbers," ENR (Engineering News-Record), May 1, 1995, pp. 18-26.

The Proteus Security Group, [www.http://anti-terrorism.com](http://anti-terrorism.com), ECSI International, Copyright 1997.

Rosenheck, Thierry, "Security and Image for Embassy Office Buildings: Attempting to Balance Conflicting Demands," Special Security Situations, December, 10, 1993, pp. 78-83.

Schultz, Donald O., Principles of Physical Security, Gulf Publishing Company, Houston, TX, 1978.

Shenon, Philip, "Embassies shut down by threats," The Gainesville Sun, Aug. 12, 1998, p. 1A.

Sherman, Lawrence, et al, What Works, What Doesn't, What's Promising: A Report to the United States Congress, U.S. Department of Justice, Office of Justice Programs, Washington, D.C., Feb. 1997.

Thomas, Evan, "Serious Errors in Judgment," Time, 123, Jan. 2, 1984, pp. 56-57.

Tucson Police Department, Community Service Division, Safe By Design, City of Tucson, 1989.

Wilson, James Q. and Kelling, George L., "Broken Windows," Atlantic Monthly, 211, 1982, pg29-38.

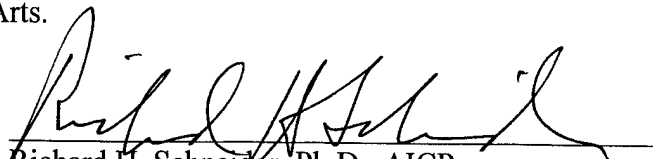
BIOGRAPHICAL SKETCH

Juliana Prevatt received her undergraduate degree in Architecture from Virginia Polytechnic Institute and State University (VPI) in 1989. She will receive her Masters Degree in Urban and Regional Planning, with an environmental specialization, from the University of Florida in December 1998.

Ms. Prevatt is an officer in the United States Navy, Civil Engineer Corps, and has been on active duty for the past nine years. She currently holds the rank of Lieutenant. During her time in the Navy she has been stationed in Guam, working both as an Assistant Resident Officer in Charge of Construction and as the Environmental Officer for the Naval commands on the island. She was then transferred to Norfolk, VA, where she interned as an architect for a year before receiving her architectural registration (R.A.) from the state of Maryland in 1995. She also did a second construction job in Norfolk before attending graduate school.

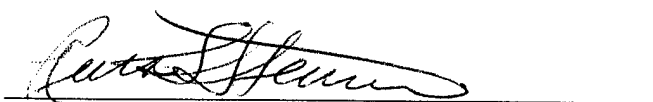
Her next job with the Navy is scheduled to start in January 1999. She will be going to work in Washington, D.C. with the environmental group at the Naval Sea Systems Command (COMNAVSEASYSCOM.) In the future, she hopes to work with the Navy in a facility planning capacity.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a final project for this degree of Master of Arts.



Richard H. Schneider, Ph.D., AICP
Associate Professor of
Urban and Regional Planning

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a final project for this degree of Master of Arts.



Ruth L. Steiner, Ph.D.
Assistant Professor of
Urban and Regional Planning

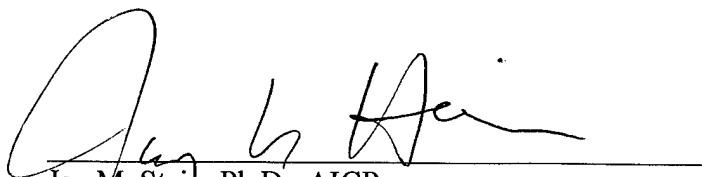
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Robert R. Grist
Associate Professor of
Landscape Architecture

This project was submitted to the Graduate Faculty of the Department of Urban and Regional Planning, to the College of Architecture, and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Master of Arts.

December 1998



Jay M. Stein, Ph.D., AICP
Professor and Chairman of
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