UFC 4-010-01
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UNIFIED FACILITIES CRITERIA (UFC)

DoD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS

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Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes UFC 4-010-01 Change 1, dated October 2013.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code (General Building Requirements)*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*

Superseding: UFC 4-010-01 Change 1, dated October 2013 and cancels UFC 4-010-02.

Description: The purpose of this criteria is to establish minimum engineering standards for DoD projects that incorporate antiterrorism (AT) based mitigating measures not associated with an identified threat or level of protection. The intent of these standards is to reduce collateral damage and the scope and severity of mass casualties in buildings or portions of buildings owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD in the event of a terrorist attack. This document applies to all DoD Components and to all DoD inhabited buildings as defined in the applicability section of this UFC.

Information in Chapter 4 and Appendix B will be removed when UFC 4-027-01, Design to Mitigate Terrorist Attacks in Expeditionary Environments and UFC 4-020-02: Security Engineering Facilities Design Manual are published.

Reasons for Document:

- This UFC establishes the minimum engineering standards that incorporate antiterrorism based mitigating measures not associated with an identified threat against DoD personnel and assets. This document has been updated to remove mitigation measure tied to a specific explosive weight.

Impact:

- This revision will likely reduce the cost of construction for facilities that do not require a higher level of protection, and will promote efficiencies in land use and installation comprehensive planning.

Unification Issues

- There are no unification issues.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

One of the findings in the 1996 Downing Commission report on the Khobar Towers bombing in Dhahran, Saudi Arabia was that there were no standards for force protection in fixed DoD facilities. In partial response to that finding, the initial version of this document was published as an interim standard in December 1999. It applied to Military Construction (MILCON) funded new construction and major renovations of DoD buildings beginning with the Fiscal Year 2002 program. It was transmitted by a memorandum dated 20 September 2002 from the Undersecretary of Defense for Acquisition, Technology and Logistics (USD (AT&L)) and was referenced as a requirement by DoD Instruction 2000.16.

1-2 PURPOSE AND SCOPE.

The purpose of this standard is to establish minimum engineering standards that incorporate antiterrorism (AT) based mitigating measures where no identified threat or level of protection has been determined in accordance with UFC 4-020-01.

1-3 INTENT.

The intent of these standards is to reduce collateral damage and the scope and severity of mass casualties in the event of a terrorist attack. These standards provide cost effective, implementable, and enforceable construction standards to protect personnel against terrorist attacks. While complete protection against all potential threats for every inhabited building is cost prohibitive, the intent of these standards can be achieved through prudent master planning, real estate acquisition, and design and construction practices.

1-4 IMPLIMENTATION.

Implement in accordance with the Implementation, Administration, and Enforcement paragraph in UFC 1-200-01. These standards apply to projects funded under host-nation agreements after the implementation date of these standards or as soon as negotiations with the foreign governments can be completed.

Due to major changes between these standards and previous editions, projects currently under design and beyond 35% completion may consider complying with these standards where possible.

1-5 APPLICABILITY.

These standards apply to all DoD Components, to all DoD inhabited buildings and high occupancy family housing, to all inhabited tenant buildings on DoD installations, and to all DoD expeditionary structures.

1-5.1 New Construction.

Implementation of these standards is mandatory for all new construction regardless of funding source.

1-5.2 Existing Buildings.

Implementation of these standards is mandatory to existing buildings when triggered as specified below, regardless of funding source.

1-5.2.1 Major Investments.

Implementation of these standards to bring entire inhabited buildings into compliance is mandatory for all DoD building renovations, modifications, repairs, revitalizations, and restorations where project costs exceed 50% of the replacement cost of the existing building in accordance with UFC 3-701-01 except as otherwise stated in these standards. The 50% cost is exclusive of the costs identified to meet these standards.

Where costs do not exceed the 50% threshold, compliance with these standards is recommended, but not required.

1-5.2.2 Change of Occupancy Level.

Implementation of these standards is mandatory when any building or portion of a building is converted from low occupancy to inhabited occupancy. Examples would include a warehouse (low occupancy) being converted to administrative (inhabited) use.

1-5.2.3 Window, Skylight, Glazing, and Door Replacement Projects.

Because of the significance of glazing hazards in a blast environment, implementation of all provisions of Standard 10 is mandatory for existing inhabited buildings any time a window, skylight, or glazing is being replaced. This also applies to installation of supplemental windows behind existing windows (inside face) and to installations of windows in new openings.

Because of the significance of door hazards in a blast environment, implementation of all provisions of Standard 12 is mandatory for existing inhabited buildings any time doors are being replaced.

1-5.2.4 Heating, Ventilating, and Air Conditioning (HVAC) Systems and Associated Controls.

Whenever HVAC systems featuring outside air intakes or control systems associated with HVAC systems including outside air intakes are being replaced or modified, apply provisions of Standard 18. Modifications include, but are not limited to modifications such as complete air handling unit replacement, outside air control damper replacement, major ductwork reconfiguration, control system replacement, and control system reprogramming. Modifications do not include replacement of or repair of components such as coils and fans and do not include control system software updates

or reprogramming in support of additional equipment added to an existing control system.

1-5.3 Building Additions.

Inhabited additions to existing buildings must comply with the minimum standards for new buildings. If the addition is 50% or more of the gross area of the existing building, the existing building will comply with the minimum standards for existing buildings in Chapter 3. Cost of building additions will not be included in calculating the 50% trigger for major investments.

Throughout these standards references to new construction will be considered to be inclusive of additions to existing buildings.

1-5.4 Leased Buildings.

In accordance with DoD Instruction 2000.12, the security standards established by the Interagency Security Committee (ISC) in Physical Security Criteria for Federal Facilities must apply to all off-installation leased space managed by DoD and all DoD occupied space in buildings owned or operated by the U.S. General Services Administration (GSA). The ISC standards apply to leased space in the U.S. and in foreign countries. Current tenants and tenants who initiated lease requests prior to 7 December 2012 must apply the ISC standards in accordance with existing lease agreements to the extent practicable.

1-5.5 Privatized Buildings.

Privatized inhabited buildings and high occupancy family housing that meet the applicability provisions above, will comply with these standards.

1-5.6 DoD Purchases of Existing Buildings.

Existing inhabited buildings purchased for use by DoD will comply with the minimum standards for existing buildings. Those buildings will meet the requirements before they can be occupied by DoD personnel.

1-5.7 Non-DoD Tenant Buildings on DoD Installations.

Tenant buildings on DoD installations other than those that meet one of the exemptions below are required to comply with these standards because it is assumed that the tenant buildings are likely to be turned over to DoD sometime during their design life and that they will then be occupied by DoD personnel. For the purposes of these standards, occupancies for non-DoD tenant-built building will be calculated assuming that building occupants are DoD personnel.

1-5.8 National Guard Buildings.

National Guard buildings that use Federal funding for new construction, renovations, modifications, repairs, or restorations that meet the applicability provisions above, will comply with these standards.

1-5.9 Expeditionary Structures.

Implementation of these minimum standards is mandatory for all expeditionary structures that meet the occupancy criteria for inhabited buildings. See Chapter 4 for structure types that meet the expeditionary structures criteria. Many expeditionary structures are in forward operating locations where there is a conventional and/or terrorist threat more severe than those addressed in these standards. In those situations, more detailed planning and additional measures are needed for providing protection. Refer to the GTA 90-01-011, Joint Forward Operations Base (JFOB) Survivability and Protective Construction Handbook.

1-5.9.1 New Structures.

These standards apply to all new expeditionary structures effective as of the implementation date of these standards.

1-5.9.2 Existing Structures.

These standards will apply to all existing expeditionary structures as they undergo major modifications or renovations as of the implementation date of these standards.

1-6 EXCEPTIONS.

The following buildings are exempt from all provisions of these standards. Compliance with these standards for those buildings is recommended where possible. In addition, there are some exemptions to individual standards that are included in the text of those standards in CHAPTER 3.

1-6.1 Low Occupancy Buildings.

Buildings whose occupancies do not meet the occupancy levels of inhabited buildings.

1-6.2 Low Occupancy Family Housing.

Family housing with 12 units or fewer per building.

The exemption of family housing with 12 units or fewer in a single building acknowledges that the density of such units is generally low, reducing the likelihood of mass casualties. It also acknowledges the fact that low-density housing has rarely been directly targeted by terrorists.

1-6.3 Fisher Houses.

Fisher houses with 24 units or fewer.

1-6.4 Town Centers.

Town Center buildings that include retail, health, or community services space on the first floor and not more than 12 units of family housing above that space.

This exception does not apply where the buildings contain any occupancy other than retail, health, community services, and family housing or where the retail space is more than half of the total area of the family housing.

1-6.5 Enhanced Use Leases.

Facilities associated with enhanced use leases on DoD installations, unless a facility warrants additional force protection due to its specific purpose and/or location per title 10 U.S.C. section 2667(b)(8). Application of these standards must be justified on a case-by-case basis.

1-6.6 Transitional and Temporary Structures and Spaces.

Buildings, structures, and spaces that are required for limited durations to maintain operations during construction, for other temporary mission requirements, or for administering construction contracts.

Lightweight buildings or trailers are frequently provided for these structures, and those kinds of structures are commonly not commercially available with construction such as laminated glass windows that will meet these standards. Enforcing the standards on those structures, therefore, would be of questionable economic feasibility for the short duration for which they are anticipated to be used.

1-6.6.1 Transitional Structures and Spaces.

Buildings and structures, including buildings and structures leased to provide transitional spaces during the life of the construction or renovation contract for which the transitional buildings and structures are being provided, but no longer than 5 years.

1-6.6.2 Temporary and Relocatable Buildings.

Temporary and relocatable buildings that are intended for use for less than 5 years in non-expeditionary environments are exempt from all provisions of these standards.

1-6.7 Military Protective Construction.

Facilities designed to the North Atlantic Treaty Organization (NATO) (or equivalent) standards for collaterally protected, semi-hardened, protected, and hardened facilities are exempt from all provisions of these standards. (Refer to Supreme Headquarters Allied Power Europe (SHAPE) document 6160/SHLOFA-059-82.)

These facilities are exempted because the military conventional and nuclear weapons threats to which they are designed are much more stringent than those included in these standards due to their purpose of protecting critical military functions. Facilities designed to protective construction standards will provide higher levels of protection for facility occupants than those required by these standards.

1-6.8 Parking Structures.

Parking structures are exempt from these standards except where there are areas built into the structures that meet the definition of inhabited buildings. People accessing their vehicles do not need to be included in any calculation of population or population density.

1-7 OCCUPANCY CALCULATION.

The starting point for applying the Standards is based on buildings or portions of buildings being routinely occupied by 11 or more DoD personnel and with a population density of greater than one person per 430 gross square feet (40 gross square meters). The determination of occupancy is usually straightforward but in some cases there are questions on how to calculate occupancies. The following are examples of how to determine occupancy.

1-7.1 Gas Stations and Car Care Centers.

Where DoD or non-DoD visitors to Gas Stations and Car Care Centers routinely increase the occupancy of those buildings to levels meeting the definition of inhabited buildings, those buildings will comply with these standards.

1-7.2 Visitor Centers and Museums.

Where DoD or non-DoD visitors to visitor centers, museums, and similar buildings on DoD property routinely increase the occupancy of those buildings to levels meeting the definition of inhabited buildings, those buildings will comply with these standards.

1-7.3 Visitor Control Centers at Entry Control Facilities / Access Control Points.

Where DoD personnel and the average daily peak occupancy of visitors routinely increase the occupancy of those buildings to levels meeting the definition of inhabited buildings, those buildings will comply with these standards. See UFC 4-022-01 for average daily occupancy calculation.

1-8 REGULATORY AUTHORITIES.

The following regulatory authorities may establish antiterrorism related requirements in addition to the Standards in this UFC.

1-8.1 DoD and Heads of DoD Components.

DoD and heads of DoD Components may establish additional guidance or standards for facilities under their authority or to account for any component related special circumstances.

1-8.2 Geographic Combatant Commanders.

Geographic Combatant Commanders (GCC) may establish additional guidance or standards within their areas of operations. Such guidance is typically included in Antiterrorism Operations Orders (OPORD).

1-8.3 Installation Specific Requirements.

As required by DoD Instruction O-2000.16 and service directives, each installation must have an Antiterrorism Plan. The plan provides procedures and recommendations for reducing risk and vulnerability of DoD personnel, their family members, facilities, and assets from acts of terrorism. Installation Antiterrorism Plans may define a Design Basis Threat for the installation; however, UFC 4-020-01 must be used to validate the Design Basis Threat and level of protection for individual projects.

1-9 EXPLOSIVE SAFETY STANDARDS.

These antiterrorism standards establish criteria to minimize mass casualties and progressive collapse of buildings from terrorist attacks. DoD 6055.09-M, DoD Ammunition and Explosives Safety Standards as implemented by Service component explosive safety standards, establish acceptable levels of protection for accidental explosions of DoD-titled munitions. The explosive safety and antiterrorism standards address hazards associated with unique events; therefore, they specify different levels of protection. Compliance with both standards is required where applicable. Where conflicts arise, the more stringent criteria will govern.

1-10 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code (General Building Requirements)*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

It is assumed that the provisions of these standards will be coordinated with all other applicable DoD building and design criteria and policies. Nothing in these standards should be interpreted to supersede the provisions of any other applicable building or design criteria. Where other criteria mandate more stringent requirements, the most stringent is applicable.

1-11 PROJECT PLANNING AND DESIGN CRITERIA.

The standards contained within this document do not establish the Design Basis Threat or Level of Protection for DoD buildings. Use UFC 4-020-01 to establish the Design Basis Threat and Level of Protection for individual projects.

1-12 HISTORIC PRESERVATION COMPLIANCE.

1-12.1 Security and Stewardship.

The Department of Defense remains the lead federal agency in balancing security threats with the protection of historic properties. The Department of Defense abides by federal legislation on protecting cultural resources, and issues its own complementary policies for stewardship.

1-12.2 Compliance with Laws.

Implementation of these standards will not supersede DoD's obligation to comply with federal laws regarding cultural resources to include the National Historic Preservation Act (NHPA) and the Archaeological Resources Protection Act (ARPA). Installation personnel must determine possible adverse effects to historic structures and/or archaeological resources during project development and consult accordingly. Personnel at installations outside the United States should coordinate with the applicable host nation regarding possible adverse effects to cultural resources.

1-12.3 Compliance with DoD Standards.

Conversely, historic preservation compliance does not negate the requirement to implement other Department of Defense policy. Federal agencies are always the decision-maker in the Section 106 process of the National Historic Preservation Act. An agency should seek to avoid prolonged consultations that conflict with the eminent need to implement security requirements. Preservation considerations and antiterrorism standards are not mutually exclusive, and any compliance conflicts should be quickly and effectively resolved in consultation with appropriate stakeholders.

1-13 GLOSSARY.

APPENDIX D contains acronyms, abbreviations, and definitions of terms.

1-14 REFERENCES.

APPENDIX E contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

1-15 PLANNING AND INTEGRATION.

When the best procedures, proper training, and appropriate equipment fail to deter terrorist attacks, adherence to these standards goes toward mitigating the possibility of

mass casualties from terrorist attacks against DoD personnel in the buildings in which they work and live. Although predicting the specific threat is not possible, proper planning and integration of those plans provide a solid foundation for preventing, and if necessary reacting, when terrorist incidents or other emergencies unfold.

1-15.1 Threat-Specific Requirements.

Determining the Design Basis Threat is an installation function requiring programmers, antiterrorism officers, and members of the threat working group. Determining the facility Design Basis Threat is the first step in planning antiterrorism requirements. However, without a defined level of protection, only the minimum standards apply. The Design Basis Threat and level of protection are unique for each individual facility and are based on the threat likelihoods and the values of the assets in the building. Use UFC 4-020-01 to determine the Design Basis Threat and level of protection for individual projects. The process outlined in UFC 4-020-01 will determine if the minimum AT standards are adequate or if additional protective measures are required.

1-15.2 Effective Planning.

An effective planning process facilitates the necessary decision making, clarifies roles and responsibilities, and ensures support actions generally go as planned. A team consisting of the chain of command and key personnel from all appropriate functional areas who have an interest in the building and its operation executes this planning process. The team should include, as a minimum, antiterrorism/force protection, intelligence, security, and facility engineering personnel. This team is responsible for identifying requirements for the project, facilitating the development of supporting operational procedures, obtaining adequate resources, and properly supporting all other efforts needed to prudently enhance protection of the occupants of every inhabited DoD building. For further information on planning and integration, refer to UFC 4-020-01.

1-15.3 Critical Facilities.

Buildings that must remain mission operational during periods of national crisis and may be subjected to terrorist attack may warrant design to higher levels of protection than those provided by these standards. Ensure detailed risk and threat assessments are executed using UFC 4-020-01 for buildings containing critical assets.

1-16 MASTER PLANS.

Installation master plans must include roadmaps for new and existing facilities. Master plans should consider threats and levels of protection for facilities. For site planning this may include standoff from parking, base perimeters, and entry control facilities / access control points, but it can also include utilities, vantage points, and the location of high value assets.

1-17 SECURITY ENGINEERING UFC SERIES.

This UFC is one of a series of security engineering unified facilities criteria documents that cover minimum standards, planning, preliminary design, and detailed design for security and antiterrorism. The manuals in this series are designed to be used sequentially by a diverse audience to facilitate development of projects throughout the design cycle. The manuals in this series include the following:

1-17.1 DoD Minimum Antiterrorism Standards for Buildings.

This UFC establishes standards that provide minimum protection against terrorist attacks for the occupants of all DoD inhabited buildings. This UFC is intended to be used by security and antiterrorism personnel and design teams to identify the minimum requirements that must be incorporated into the design of all new construction and major renovations of inhabited DoD buildings and inhabited tenant buildings on DoD installations. They also include recommendations that should be, but are not required to be incorporated into all such buildings.

1-17.2 Security Engineering Facilities Planning Manual.

UFC 4-020-01 presents processes for developing the design criteria necessary to incorporate security and antiterrorism into DoD facilities and for identifying the cost implications of applying those design criteria. Those design criteria may be limited to the requirements of the minimum standards, or they may include protection of assets other than those addressed in the minimum standards (people), aggressor tactics that are not addressed in the minimum standards, or levels of protection beyond those required by the minimum standards. The cost implications for security and antiterrorism are addressed as cost increases over conventional construction for common construction types. The changes in construction represented by those cost increases are tabulated for reference, but they represent only representative construction that will meet the requirements of the design criteria. The manual also addresses the tradeoffs between cost and risk. The Security Engineering Facilities Planning Manual is intended to be used by planners as well as security and antiterrorism personnel with support from planning team members.

1-17.3 Security Engineering Facilities Design Manual.

UFC 4-020-02FA provides interdisciplinary design guidance for developing preliminary systems of protective measures to implement the design criteria established using UFC 4-020-01. Those protective measures include building and site elements, equipment, and the supporting manpower and procedures necessary to make them all work as a system. The information in UFC 4-020-02FA is in sufficient detail to support concept level project development, and as such can provide a good basis for a more detailed design. The primary audience for the Security Engineering Design Manual is the design team, but it can also be used by security and antiterrorism personnel.

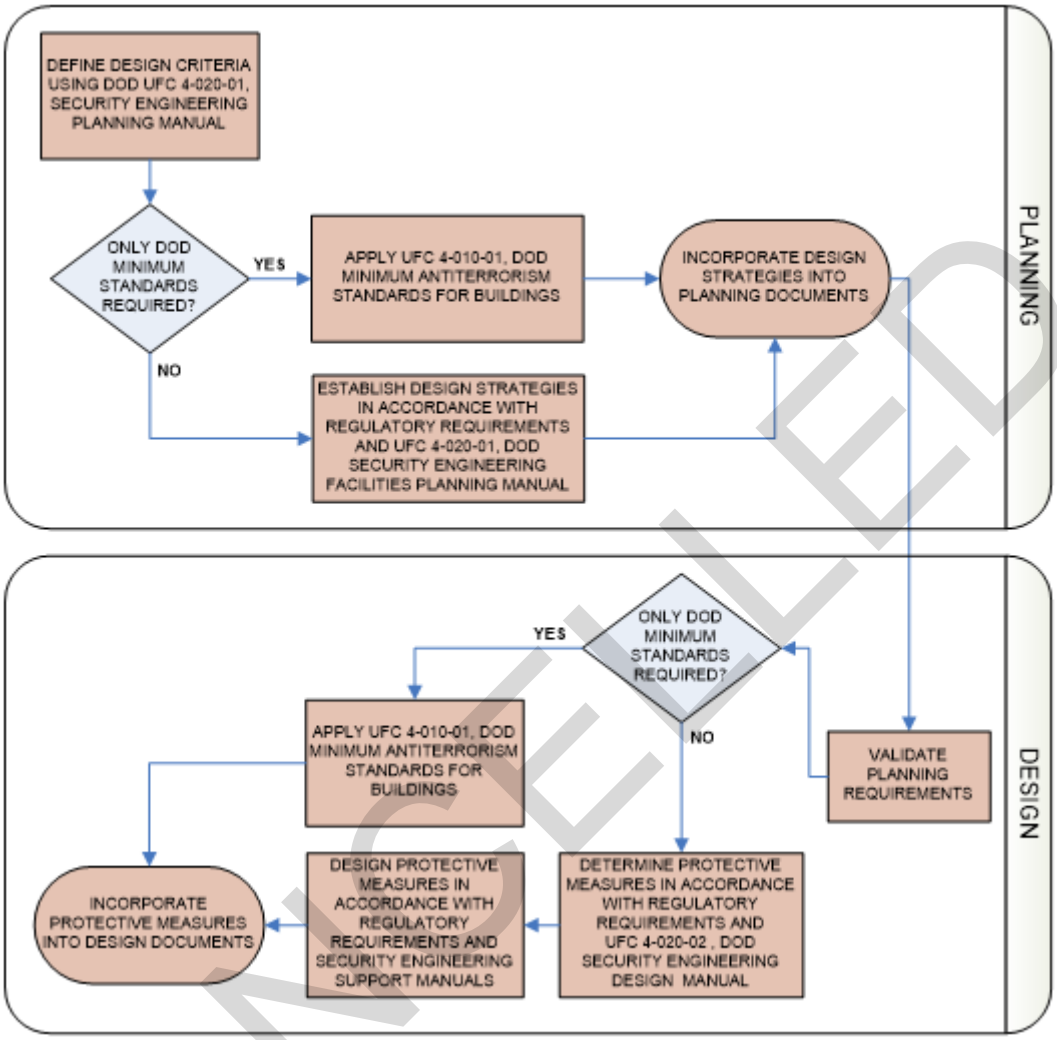
1-17.4 Security Engineering Support Manuals.

In addition to the standards, planning, and design UFCs mentioned above, there is a series of additional UFCs that provide detailed design guidance for developing final designs based on the preliminary designs developed using UFC 4-020-02. These support manuals provide specialized, discipline specific design guidance. Some address specific tactics such as direct fire weapons, forced entry, or airborne contamination. Others address limited aspects of design such as resistance to progressive collapse or design of portions of buildings such as mail rooms. Still others address details of designs for specific protective measures such as vehicle barriers or fences. The Security Engineering Support Manuals are intended to be used by the design team during the development of final design packages.

1-17.5 Security Engineering UFC Application.

The application of the security engineering series of UFCs is illustrated in Figure 1-1. UFC 4-020-01 is intended to be the starting point for any project that is likely to have security or antiterrorism requirements. By beginning with UFC 4-020-01, the design criteria will be developed that establishes which of the other UFCs in the series will need to be applied. The design criteria may indicate that only the minimum standards need to be incorporated, or it may include additional requirements, resulting in the need for application of additional UFCs. Applying this series of UFCs in the manner illustrated in Figure 1-1 will result in the most efficient use of resources for protecting assets against security and antiterrorism related threats.

Figure 1-1 Security Engineering UFC Applicability



1-18 STANDARDS AND RECOMMENDATIONS.

Mandatory DoD minimum antiterrorism standards for new and existing inhabited buildings are contained in Chapter 3. Mandatory DoD minimum antiterrorism standards for expeditionary structures are contained in Chapter 4. Where specific Design Basis Threat and level of protection are identified, additional guidance is included in APPENDIX B.

Additional recommended measures for new and existing inhabited buildings are included in APPENDIX A. The standards and recommendations in this document include a combination of performance and prescriptive requirements. In many cases where there are minimum prescriptive requirements, those requirements are based on performance standards and there are generally provisions to allow those performances to be provided through alternate means where those means will provide the required levels of protection.

CHAPTER 2 PHILOSOPHY, DESIGN STRATEGIES, AND ASSUMPTIONS

2-1 GENERAL.

The purpose of this chapter is to clarify the philosophies on which these standards are based, the design strategies that are their foundation, and the assumptions inherent in their provisions. The further purpose of this chapter is to provide background and rationale for the requirements in Chapter 1 and Chapter 3; therefore, nothing in this chapter should be construed to establish a requirement. Effective implementation of these standards depends on a reasonable understanding of the rationale for them. With this understanding, engineers and security and antiterrorism personnel can maximize the efficiency of their solutions for complying with these standards while considering site-specific threat and mission related issues and constraints that might dictate measures beyond these minimums.

2-2 PHILOSOPHY.

The overarching philosophy upon which this document is based is that comprehensive protection for every inhabited facility against the range of possible threats is cost prohibitive, but that appropriate protective measures can be provided for all DoD personnel at a reasonable cost. Those protective measures are engineering solutions intended to lessen the risk of mass casualties resulting from terrorist attacks. Implementation of these standards will provide some protection against a wide range of threats and will reduce injuries and fatalities. The costs associated with these standards are assumed to be less than the physical and intangible costs associated with incurring mass casualties.

Furthermore, all DoD decision makers must commit to making smarter investments with the scarce resources available and stop investing money in inadequate buildings that DoD personnel will have to occupy for decades, regardless of the threat environment. There are two key elements of this philosophy that influence the implementation of these standards.

2-2.1 Time.

Protective measures must be in place prior to the initiation of a terrorist attack. Incorporating those measures into DoD buildings and inhabited tenant buildings on DoD installations is least expensive at the time those buildings are being constructed, are undergoing major renovation, repair, restoration, or modernization, or when existing buildings are being purchased. Because of that investment strategy, it is recognized that it may take significant time before all DoD buildings and inhabited tenant buildings on DoD installations comply with these standards.

2-2.2 Design Practices.

The philosophy of these standards is to build a baseline level of resistance to terrorist attack into all DoD inhabited buildings. That philosophy affects the general practice of designing inhabited buildings. While these standards are not based on an identified threat or level of protection, they are engineering solutions intended to provide the

easiest and most economical methods to minimize injuries and fatalities in the event of a terrorist attack. The primary methods to achieve this outcome are to construct superstructures to avoid progressive collapse, minimize hazardous flying debris, provide effective building layout, limit airborne contamination, and provide building mass notification. These and related design issues are intended to be incorporated into standard design practice.

2-3 DESIGN STRATEGIES.

There are several major design strategies that are applied throughout these standards. They do not account for all of the measures considered in these standards, but they are the most effective and economical in protecting DoD personnel from terrorist attacks. These strategies are summarized below.

2-3.1 Prevent Building Collapse.

Provisions for preventing building collapse are essential to minimizing mass casualties of building occupants. Those provisions apply regardless of standoff distance or the ability of buildings to resist blast effects since structural systems that provide greater continuity and redundancy among structural components will help limit collapse for any extreme loading events.

2-3.2 Minimize Hazardous Flying Debris.

In past explosive events where there was no building collapse, a high number of injuries resulted from flying glass fragments and debris from walls, ceilings, and fixtures (non-structural features). Flying debris can be minimized through building design and avoidance of certain building materials and construction techniques. The glass used in most windows breaks at very low blast pressures, resulting in hazardous, dagger-like fragments. Minimizing those hazards through reduction in window numbers and sizes and through enhanced window construction has a major effect on limiting mass casualties. Hazardous fragments may also include secondary debris from such sources as barriers and site furnishings.

2-3.3 Provide Effective Building Layout.

Effective design of building layout and orientation can significantly reduce opportunities for terrorists to target building occupants or injure large numbers of people.

2-3.4 Limit Airborne Contamination.

Effective design of heating, ventilation, and air conditioning (HVAC) systems can significantly reduce the potential for chemical, biological, and radiological agents being distributed throughout buildings.

2-3.5 Provide Building Mass Notification.

Providing a timely means to notify building occupants of threats and what should be done in response to those threats reduces the risk of mass casualties. Effective designs will include means for both local and remote origination of information.

2-4 ASSUMPTIONS.

This section includes assumptions that form the foundation of these standards and assumptions and philosophies behind some of the provisions of these standards.

2-4.1 Baseline Antiterrorism Protective Measures.

The location, severity, and nature of terrorist threats are unpredictable. It would be cost prohibitive to provide protection against the worst-case scenario in every building. These standards provide a reasonable baseline of antiterrorism protective measures for inhabited DoD buildings and inhabited tenant buildings on DoD installations. Designing to these standards will provide general collateral protection and will establish a foundation upon which to build additional measures where justified by higher threats or when the threat environment increases in the future.

The terrorist threats addressed in these standards are further assumed to be directed against DoD personnel. Threats to other assets and critical infrastructure and specific threats to facilities are beyond the scope of these standards, but they are addressed in UFC 4-020-01. The following are the terrorist tactics upon which these standards are based:

2-4.1.1 External Explosive Threats.

These minimum standards are not based on a specific Design Basis Threat identified against the facility being designed. These minimum standards provide collateral damage protection for threats directed against other nearby facilities.

2-4.1.2 Mail Bombs.

Explosives in packages delivered through the mail can cause significant localized damage, injuries, and fatalities if they detonate inside a building. No assumption as to the size of such explosives is made in these standards. Provisions for mail bombs are limited to specifying locations of mail rooms so that they can be more efficiently hardened if a specific threat of a mail bomb is identified in the future.

2-4.1.3 Chemical, Biological, and Radiological Weapons.

For the purposes of these standards, these weapons are assumed to be improvised weapons containing airborne agents employed by terrorists. These standards do not assume comprehensive protection against this threat. They provide means to reduce the potential for widespread dissemination of such agents throughout buildings in the event of an attack either outside buildings or in mail rooms.

2-4.2 Policies and Procedures.

It is assumed that policies and procedures will be developed to support these standards and other related issues and that those policies and procedures will be incorporated into antiterrorism plans, training, and exercises. It is assumed for the purposes of these standards that policies and procedures will be developed by physical security personnel at individual installations or buildings based on their local capabilities and situations.

2-4.3 Training.

It is assumed that key security and facility personnel will receive training in security engineering, antiterrorism, physical security, and related areas. It is further assumed that all DoD personnel have been trained in basic antiterrorism awareness in accordance with DoD Instruction O-2000.16, that they are able to recognize potential threats, and that they know the proper courses of action should they detect a potential threat.

CHAPTER 3 STANDARDS

3-1 INTRODUCTION.

The purpose of this chapter is to establish standards to provide appropriate protective measures for the protection of DoD personnel at a reasonable cost. These standards represent engineering solutions intended to lessen the risk of mass casualties and collateral damage resulting from terrorist attacks. Implementation of these standards will provide some protection against a wide range of threats and should reduce injuries and fatalities.

The standards in this chapter provide the minimum protective measures for DoD inhabited buildings. Engineers, security and antiterrorism personnel must consider site-specific threats, mission related issues and constraints that might dictate measures beyond these minimums. Use UFC 4-020-01 to establish project requirements and determine if these minimum standards are adequate or if additional mitigation measures are required. The engineering risk analysis conducted as part of UFC 4-020-01 should be consistent with the terrorism risk analysis conducted by the installation security/AT staff.

3-2 STANDARD 1. STANDOFF DISTANCE.

The previous version of Standard 1 established standoff distances to parking, roadways, and controlled perimeters that were based on building construction and occupancy. In this revision of Standard 1, standoff distances only apply to distances to installation perimeters for new construction and additions to existing buildings that are required to comply with these standards.

Exception: Existing buildings within an installation perimeter are exempt from this standard.

3-2.1 Minimum Standoff.

The minimum standoff distance for new construction and additions to existing buildings to the installation perimeter is 20 ft. (6 m). Where there is no clear zone outside the perimeter, the minimum standoff distance is 50 ft. (15 m).

For buildings that are outside an installation perimeter, use UFC 4-020-01 to establish the Design Basis Threat, level of protection and resulting standoff.

3-2.1.1 Clear Zone.

Standoff distances to installation perimeters are based on clear zone requirements. Clear zones are areas established around the perimeters to provide unobstructed views to enhance detection and assessment. Typically, clear zones are free of all obstacles, topographical features, and vegetation exceeding 8 in. (152 mm) in height that could impede observation or provide cover and concealment of an aggressor. Provide a minimum aggregate clear zone of 50 feet (15 m) inclusive of the clear zones outside and inside the installation perimeter. For example, if an outer clear zone is 20 ft. (6 m)

wide, the standoff distance to the installation perimeter must be 30 ft. (10 m) wide. Clear zones only provide unobstructed views and do not require access control. Some installations and high security areas may have higher clear zone requirements. Consult with local antiterrorism and security personnel to determine if higher clear zones are required. See Figure 3-1 and Figure 3-2.

Figure 3-1 Installation Perimeter with Outer Clear Zone

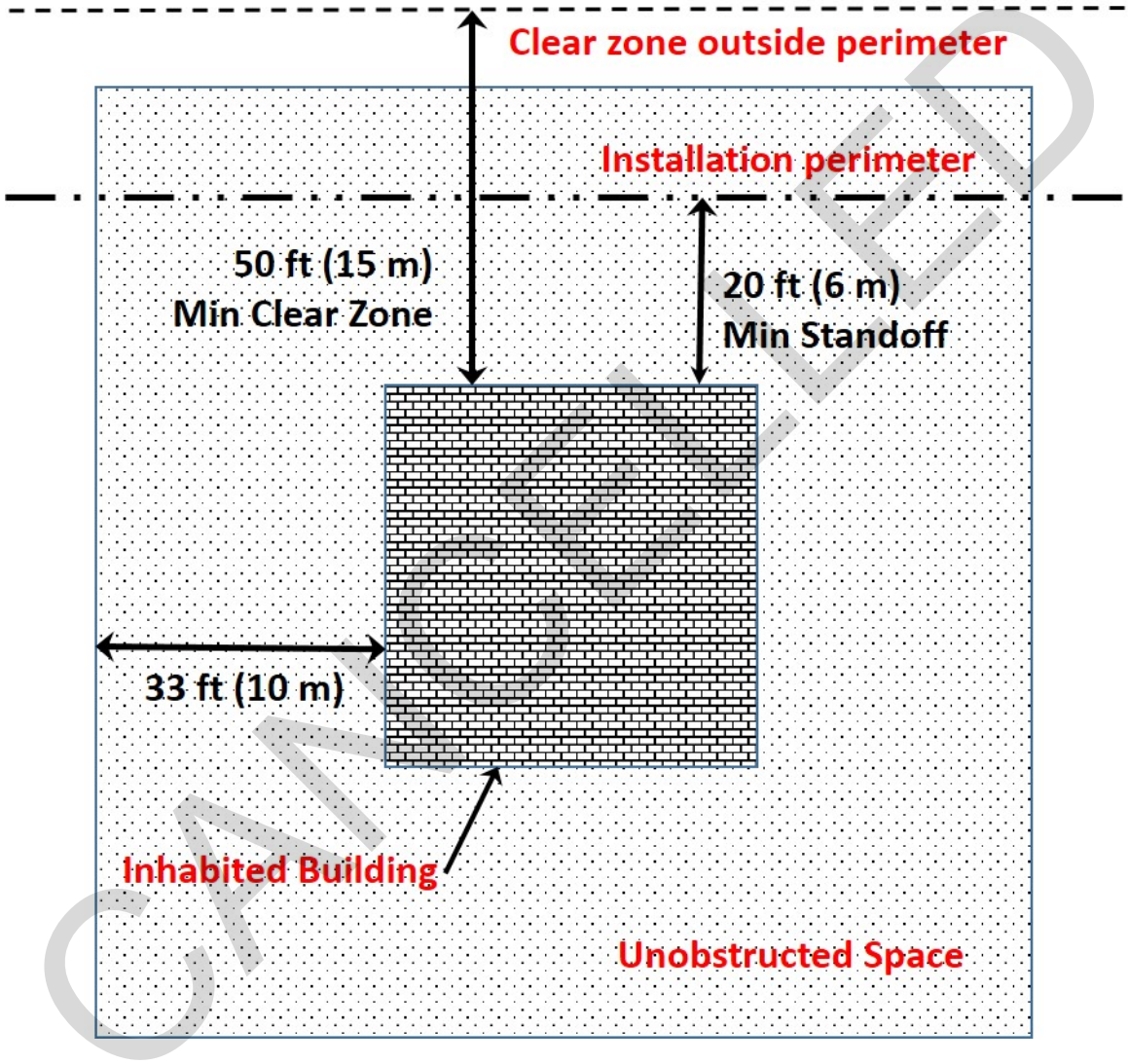
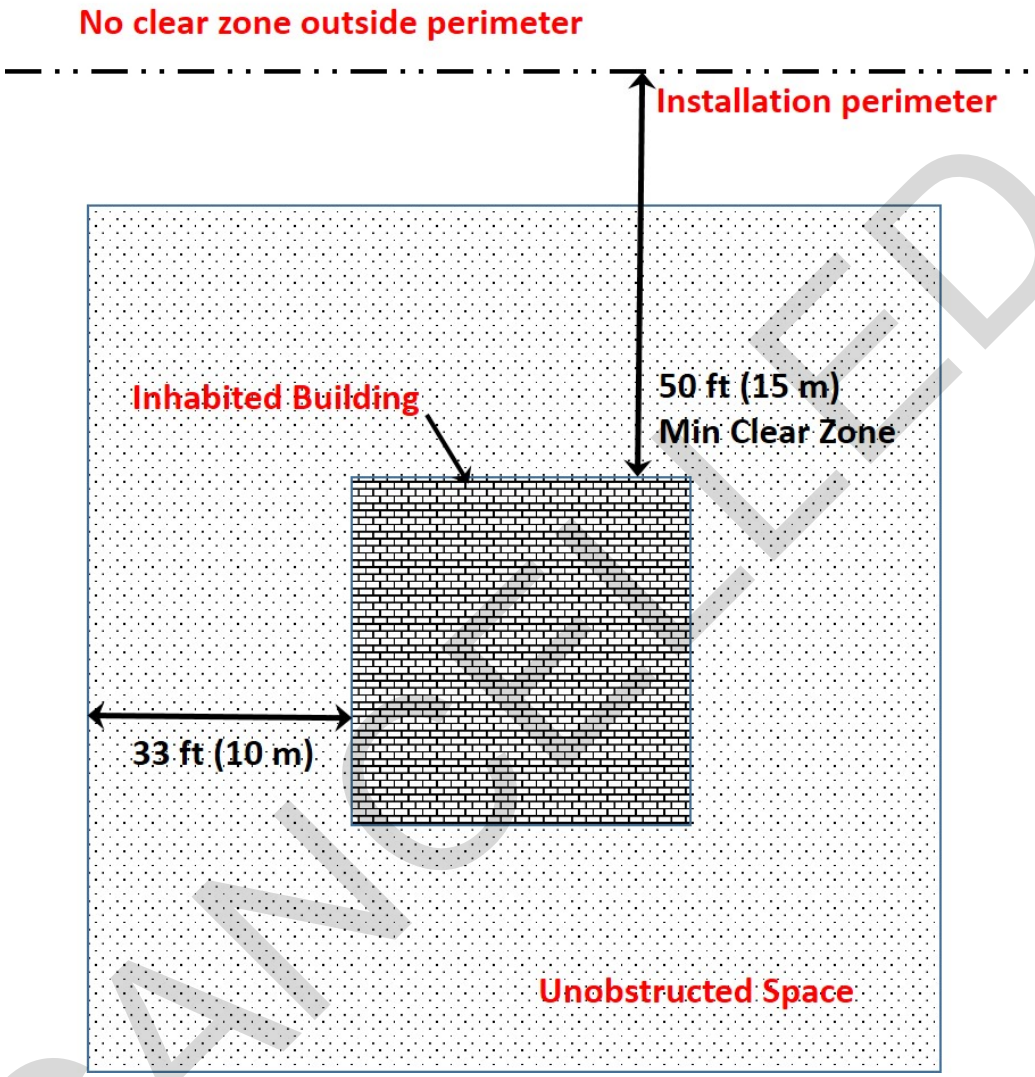


Figure 3-2 Installation Perimeter without Outer Clear Zone



3-3 STANDARD 2. UNOBSTRUCTED SPACE.

Where buildings are required to meet these standards, the unobstructed space must extend 33 ft. (10 m) out from the building, or to the installation perimeter as established by Standard 1. When the unobstructed space overlaps an established clear zone, the more stringent clear zone requirement will govern.

It is assumed that aggressors will not attempt to place explosive devices in areas near buildings where those explosive devices could be visually detected by building occupants. Ensure there are unobstructed spaces in which there are no obstructions or building features that might allow for concealment from observation of explosive devices with dimensions of no less than a 6 in. (150 mm) cube around buildings and underneath building overhangs or breezeways. This does not preclude the placement of site

furnishings or plantings around buildings. It only requires conditions such that any explosive devices placed in the unobstructed spaces would be observable by building occupants or passers by either from within the buildings or as they walk into or around it. For trees or shrubs ensure that no foliage extends lower than 3 ft. (1 m) above the grounds to improve observation of objects underneath them.

Exception:

- Stand-alone franchised fast food operations, commercial, bank, and pharmacy facilities.
- Stand Alone Shoppettes, Mini Marts, and Commissaries with areas of less than 15,000 square feet (1394 square meters).

3-3.1 Concealment.

The requirements for the unobstructed space are based on eliminating opportunities to conceal objects indicated above. The key to determining what may be located in unobstructed spaces is whether or not a person could see the objects. Obstructions such as mechanical equipment, electrical equipment, trash containers, or landscaping features may be permissible if the devices could be seen from at least one direction. Concealment establishes the basis for the requirement for above ground objects or obstructions. When applicable, evaluate indentations in landscapes such as ditches with respect to concealment.

Evaluate the capacity to conceal objects underneath and inside equipment. If there are voids into which explosives could be inserted or space underneath equipment large enough to conceal objects, that equipment will need to be secured if it is within the unobstructed space. The test should be whether or not something could be concealed behind the equipment or trash container. If walls or other screening devices are two sided it is assumed that people could see something out of place by observation.

3-3.2 Trash Containers.

Trash containers are not allowed within the unobstructed space unless the containers are secured to preclude concealment of explosives as described above or if they are enclosed in accordance with 3-3.5.

3-3.3 Electrical and Mechanical Equipment.

Electrical and mechanical equipment may be located within unobstructed spaces if they do not provide opportunities for concealment of explosives as described above or if they are enclosed in accordance with 3-3.5.

3-3.4 Fuel Tanks.

Fuel tanks may be located within unobstructed spaces if they do not provide opportunities for concealment of explosives as described above or if they are enclosed in accordance with 3-3.5. Distances between buildings and fuel tanks are based on

flammability (not explosive equivalence); therefore, they should be determined using NFPA 30.

3-3.5 Enclosures.

When trash containers, fuel tanks or electrical or mechanical equipment within the unobstructed space provide the opportunity for concealment, they must be enclosed. Enclosures must have four sides and a top. Openings in screening materials and gaps between the ground and screens or walls making up an enclosure will not be 6 in. (150 mm) or greater. Secure any surfaces of the enclosures that can be opened so that unauthorized personnel cannot gain access. Where opaque top enclosures are provided, they will have a pitch of at least 1 vertical to 2 horizontal to increase visibility of objects thrown onto them and to increase the likelihood that the objects will slide off. Alternatively, if the vertical surfaces of the enclosures are transparent and at least 7 ft. (2.1 m) high, a top enclosure is not required.

3-3.6 Walls and Screens.

If walls or other screening devices with more than two sides are placed around trash containers, fuel tanks or electrical or mechanical equipment within the unobstructed space, provide enclosure in accordance with 3-3.5.

3-3.7 Parking Within Unobstructed Spaces.

Parking is allowed within the unobstructed space. Parking may be temporarily eliminated within the unobstructed space at a higher Force Protection Condition (FPCON).

3-3.8 Adjacent Existing Buildings.

Where projects for new and existing buildings designed in accordance with these standards are located within 33 ft. (10 m) of existing inhabited buildings that are not required to meet these standards, ensure that the unobstructed spaces for buildings that must comply with the standards are maintained between those buildings and other existing buildings. If there are opportunities for concealment in the spaces around the other existing buildings those spaces should be modified to ensure fully compliant unobstructed spaces around the buildings that must comply.

3-4 STANDARD 3. DRIVE-UP/DROP-OFF AREAS.

This standard has been removed and no longer applies.

3-5 STANDARD 4. ACCESS ROADS.

This standard has been removed and no longer applies.

3-6 STANDARD 5. PARKING BENEATH BUILDINGS OR ON ROOFTOPS.

Avoid parking beneath buildings or on rooftops of buildings required to comply with these standards. Where very limited real estate makes such parking unavoidable, the following measures must be incorporated into the design for new construction.

Ensure that access control measures are implemented to prohibit unauthorized personnel and vehicles from entering underground or rooftop parking areas. Because situations vary from location to location, the development of one standardized "one-size-fits-all" access control package (measures, procedures, and equipment) is not possible and is beyond the scope of these standards. Access control is the responsibility of installation security personnel.

3-7 STANDARD 6. PROGRESSIVE COLLAPSE RESISTANCE.

For new construction of three stories or more required to comply with these standards, provide progressive collapse resistance designed in accordance with UFC 4-023-03. This standard also applies to new construction with parking beneath or multi-level parking above inhabited space.

Progressive collapse is considered to be a significant risk for buildings of three or more stories. Basements and penthouses will be considered stories if there is space designed for human occupancy and equipped with means of egress, lighting, and ventilation that meet the local building code requirements as detailed in UFC 4-023-03.

3-7.1 Progressive Collapse Design.

Follow the design guidance in UFC 4-023-03 for new construction to reduce the potential for progressive collapse due to localized structural damage. Apply the requirements for risk category II or higher. UFC 3-301-01 defines risk categories for numbers of occupants and different types of occupancies. The design requirements in UFC 4-023-03 are related to those risk categories. Evaluate interior columns and/or walls in parking areas beneath or above inhabited areas for progressive collapse in accordance with UFC 4-023-03.

3-8 STANDARD 7. STRUCTURAL ISOLATION.

Structural isolation minimizes the possibility that collapse of one part of a building will affect the stability of the remainder of the building.

3-8.1 Building Additions.

Design building additions that are required to comply with these standards to be structurally independent from the adjacent existing buildings. Alternatively, verify through analysis that collapse of either the addition or the existing building will not result in collapse of the remainder of the building. Structural isolation is not necessary if the existing buildings have been designed in accordance with these standards (including previous versions).

3-8.2 Portions of Buildings.

Design low occupancy portions of inhabited buildings required to comply with these standards to ensure their superstructures are structurally independent from the inhabited portions of the buildings. Alternatively, verify through analysis that collapse of low occupancy portions of buildings will not result in collapse of any portion of buildings covered by these standards. This standard is not mandatory for existing structures, but it should be implemented where possible.

3-9 STANDARD 8. BUILDING OVERHANGS AND BREEZEWAYS.

For new construction required to comply with these standards, avoid building overhangs and breezeways with inhabited spaces above them where people could gain access to the areas underneath the overhangs. Where such overhangs or breezeways must be used, incorporate the following measures

3-9.1 Building Elements.

Ensure the areas underneath the overhangs or breezeways comply with the provisions of the unobstructed space requirements of Standard 2. The areas underneath the overhangs or breezeways can be considered to be extensions of the surrounding unobstructed spaces.

3-10 STANDARD 9. EXTERIOR MASONRY WALLS.

Unreinforced masonry walls are prohibited for the exterior walls of new construction required to comply with these standards. Exterior masonry walls must have vertical and horizontal reinforcement distributed throughout the wall section. The vertical reinforcement ratio must be at least 0.05%, spaced no more than 4 ft. (1200 mm) on center with reinforcement within 1.3 ft. (410 mm) of the ends of walls. The horizontal reinforcement ratio must be at least 0.025%, consisting of either joint reinforcement spaced no more than 1.3 ft. (410 mm) on center, or bond beam reinforcement spaced no more than 4 ft. (1200 mm) on center, with reinforcement within 1.3 ft. (410 mm) of the top and bottom of the wall. For conventional cavity wall construction reinforcement only needs to be in the inner wall unless other reinforcement is required by other criteria.

Wood or metal studs with brick veneer that meet the analysis assumptions of Table C-5 may be considered to meet the provisions of this standard when used in conjunction with an otherwise unreinforced masonry wall. European masonry walls that are within the range of parameters in Table C-5 and PDC Technical Report 10-01 may be considered to meet the requirements of this standard.

3-11 STANDARD 10. GLAZING.

Glazing that is in compliance with this standard is not required to be designed or constructed for blast resistance. It is intended to minimize hazardous glazing fragments.

Apply the following provisions for exterior glazing for new construction or existing buildings that are required to comply with these standards.

3-11.1 Glazing.

For glazing in exterior building elements such as storefronts, doors, windows, curtain walls, clerestories, and skylights provide no less than 1/4 in. (6 mm) nominal polycarbonate or laminated glass. The 1/4 in. (6 mm) laminated glass consists of two nominal 1/8 in. (3 mm) glass panes bonded together with a minimum of a 0.030 in. (0.75 mm) interlayer of a material designed for blast resistance. For insulated glass units (IGU), use the polycarbonate or laminated glass for the innermost pane as a minimum. For laminated glass, provide a glazing frame bite in accordance with ASTM F 2248. For polycarbonate, provide a glazing frame bite of no less than 1.5 times the polycarbonate thickness.

Monolithic glass or monolithic acrylic used as a single pane or as the inner pane of a multi-pane system is not allowed for the purposes of complying with this standard. Spandrel glass when backed by a structural wall or spandrel beam, translucent fiberglass panels, other lightweight translucent plastics, and glass unit masonry are not required to comply with this standard. Spandrel glass that is open to occupied space must be designed in accordance with this standard.

3-11.2 Exterior Stairwells, Vestibules, and Covered or Enclosed Walkways.

Glazing in stairwells, vestibules, and covered or enclosed walkways that are exterior to buildings required to comply with these standards must meet the provisions of this standard. In addition, any windows, inner doors, sidelights, and transoms that are interior to the exterior stairwells, vestibules, or covered or enclosed walkways must meet the requirements of this standard.

3-11.3 Replacement with Wall or Roof Systems.

When windows or skylights are being replaced by filling in the openings with wall or roof material fill in the openings with the same or similar construction as the adjacent wall or roof construction. Alternatively install lightweight translucent fiberglass or plastic panels in the openings.

3-11.4 Alternative Window Treatments.

Window retrofits incorporating alternative window treatments such as fragment retention films and blast curtains are not acceptable alternatives for new buildings or existing buildings that are required to comply with these standards.

The primary reason for that is the fact that such solutions commonly have much shorter design lives than laminated glazing, which requires their replacement multiple times as compared to laminated glazing. Laminated glazing, while more expensive initially, is less expensive over its life cycle. In the case of blast curtains, there needs to be operational procedures to ensure that they remain closed at all times for them to be

effective. Fragment retention films and blast curtains are good interim solutions where compliance with these standards is not required.

3-12 STANDARD 11 BUILDING ENTRANCE LAYOUT.

The areas outside of installation perimeters are commonly not under the direct control of installations. Where the main entrances to buildings face installation perimeters, people entering and exiting the buildings are vulnerable to being fired upon from vantage points outside those perimeters. Obscuration or screening that minimizes targeting opportunities and mass notification are assumed to be the primary means of protecting DoD personnel from direct fire weapons. Hardening to resist direct fire effects represents a higher level of protection than required by these standards. To mitigate those vulnerabilities, apply the following measures for buildings required to comply with these standards:

3-12.1 New Construction.

For new construction, ensure that the main entrance to the building does not face uncontrolled vantage points with direct lines of sight or provide means to block the lines of sight using mitigation such as walls, privacy fencing, or vegetation.

3-12.2 Existing Buildings.

For existing buildings where the main entrance faces uncontrolled vantage points, either use a different entrance as the main entrance or screen that entrance to limit the ability of potential aggressors to target people entering and leaving the building using mitigation such as walls, privacy fencing, or vegetation.

3-13 STANDARD 12. EXTERIOR DOORS.

For all new and existing buildings covered by these standards, ensure that all exterior doors into inhabited areas open outwards. By doing so, the doors will seat into the door frames in response to an explosive blast, increasing the likelihood that the doors will not enter the buildings as hazardous debris. Alternatively, position doors such that they will not be propelled into inhabited spaces or provide other means to ensure they do not become hazards to building occupants.

3-13.1 Glazed Doors.

Glazing in and around doors must comply with Standard 10.

3-13.2 Sliding Glass doors and Revolving Doors.

Sliding glass doors and revolving doors do not have to open outwards.

3-13.3 Overhead Doors.

Because of the nature of overhead door failures due to blast loads there are no antiterrorism requirements for overhead doors.

3-14 STANDARD 13. MAIL ROOMS AND LOADING DOCKS.

The following measures address the location of rooms to which mail or supplies are delivered or in which mail or supplies are handled in new buildings required to comply with these standards. This standard is not required for existing buildings, but it is recommended to be applied when possible. These standards need not be applied to mail rooms or loading docks to which mail or supplies that were initially delivered to a central mail or supplies handling facility. These standards should be applied to such mail rooms or loading docks where possible to account for potential changes in mail or supplies handling procedures over the life of the building. The measures in this standard involve limiting collateral damage and injuries and facilitating future upgrades to enhance protection should it become necessary. This standard does not require the hardening of mail rooms or loading docks because the mail and supplies bomb threats are beyond the scope of these standards.

3-14.1 Location.

Where new construction is required to comply with these standards, locate the mail rooms or loading docks on the perimeter of the building. By locating the mail rooms or loading docks on the building perimeters there are opportunities to modify them in the future if a mail or supplies bomb threat is identified. Where mail rooms or loading docks are located in the interiors of buildings, few retrofit options are available for mitigating the mail and supplies bomb threats. Having mail rooms and loading docks on the building perimeter avoids situations where contaminated packages would be transported through the buildings.

3-14.1.1 Proximity.

Locate mail rooms and loading docks as far from heavily populated areas of buildings and from critical infrastructure as possible. This measure will minimize injuries and damage if a mail or supplies bombs detonate in mail rooms or loading docks. Further, it will reduce the potential for wider dissemination of hazardous debris. This applies where mail rooms or loading docks are not specifically designed to resist those threats.

3-15 STANDARD 14. ROOF ACCESS.

For buildings required to comply with these standards, control access to roofs to minimize the possibility of aggressors placing explosives or chemical, biological, or radiological agents there or otherwise threatening building occupants or critical infrastructure.

3-15.1 New Construction.

For new construction eliminate all external roof access by providing access from internal stairways or ladders, such as in mechanical rooms.

3-15.2 Existing Buildings.

For existing buildings, eliminate external access where possible or secure external ladders or stairways with locked cages or similar mechanisms.

3-16 STANDARD 15. OVERHEAD MOUNTED ARCHITECTURAL FEATURES.

For new construction and existing buildings required to comply with these standards, ensure that overhead mounted features weighing 31 pounds (14 kilograms) or more (excluding distributed systems such as suspended ceilings that collectively exceed that weight) are mounted using either rigid or flexible systems to minimize the likelihood that they will fall and injure building occupants. Mount all such systems so that they resist forces of 0.5 times the component weight in any horizontal direction and 1.5 times the component weight in the downward direction. This standard does not preclude the need to design architectural feature mountings for forces required by other criteria such as seismic standards.

3-17 STANDARD 16. AIR INTAKES.

Air intakes to heating, ventilating, and air conditioning (HVAC) systems at ground level that are designed to move air throughout a building provide an opportunity for aggressors to easily place contaminants where they could be drawn into buildings. The following measures will be applied to minimize those opportunities.

Exception: Air intakes within enclosures that meet the requirements of paragraph 3-3.5 and are a minimum of 10 ft. (3 m) from the enclosure perimeter.

3-17.1 New Construction.

For new construction required to comply with these standards locate all air intakes at least 10 ft. (3 m) above the ground.

3-17.2 Existing Buildings.

For existing buildings required to comply with these standards locate all air intakes at least 10 ft. (3 m) above the ground or provide means such as exterior chimneys to extend the elevations of air intakes to at least 10 ft. (3 m).

3-18 STANDARD 17. MAIL ROOM AND LOADING DOCK VENTILATION.

For new construction required to comply with these standards, provide separate, dedicated HVAC systems for mail rooms and loading docks whose purpose is to receive initial delivery of mail or supplies. This is to ensure airborne chemical, biological, and radiological agents introduced into mail rooms and loading docks do not migrate into other areas of buildings in which the mail rooms and loading docks are located,

3-18.1 Other Heating and Cooling Systems.

Building heating and cooling systems such as steam, hot water, chilled water, and refrigerant may serve mail rooms as long as the airflow systems for the mail rooms and loading docks and other areas of the buildings in which they are located remain separate.

3-18.2 Dedicated Exhaust Systems.

Provide dedicated exhaust systems within mail rooms and loading docks to maintain slight negative air pressures (minimum of 0.05 in. of water [12.5 Pa]) with respect to the remainder of the buildings in which the mail rooms and loading docks are located so that the flow of air is into and contained in the mail rooms and loading docks. Though the airflow into the mail rooms and loading docks will not eliminate the potential spread of contamination by personnel leaving the mail room or the loading dock, it will limit the migration of airborne contaminants through openings and open doorways.

3-18.3 Outside Intakes, Relief, and Exhausts.

Provide mail room and loading dock ventilation system outside air intakes, relief air, and exhausts with low leakage isolation dampers that can be automatically closed to isolate the mail rooms and loading docks. The low leakage dampers will have maximum leakage rates of 3 cfm/square foot (15 liters/second/square meter) with a differential pressure of one inch of water gage (250 Pa) across the damper.

3-18.4 Isolation Controls.

Provide separate switches or methods of control to isolate mail rooms in the event of a suspected or actual chemical, biological, or radiological release in the mail room.

3-18.5 Walls and Sealing Joints and Doors.

Mail room and loading dock walls will extend from true floor to true ceiling and all joints will be sealed. Doors between mail rooms and loading docks and inhabited areas of buildings will have gaskets or weather stripping to minimize leakage around the doors.

3-19 STANDARD 18. EMERGENCY AIR DISTRIBUTION SHUTOFF.

For all new construction and existing buildings required to comply with these standards, provide an emergency shutoff switch in the HVAC control system. The switch will initiate a response in HVAC systems and low leakage dampers leading to the outside regardless of hand/off/auto (HOA) position within 30 seconds of switch activation subject to the guidance below.

- Switch activation may, but is not required to shut down HVAC systems that do not draw air from the outside and do not serve mail rooms.
- Switch activation will not shutdown HVAC systems, but will close dampers leading to the outside for systems whose continued operation assists in

preventing the spread of airborne contaminants and that do not serve mail rooms.
- Switch activation will not shutdown HVAC systems, but will close dampers leading to the outside for systems whose continued operation provides safety of egress pathways.

Locate the shutoff switch (or switches) to be easily accessible by building occupants by locating them similarly to building mass notification system (MNS) local operating consoles (LOC) (see UFC 4-021-01 for additional information on MNS LOCS) so that the travel distance to the nearest shutoff switch will not be in excess of 200 ft. (61 m). Ensure that the shutoff switches are well labeled, and of a different color than fire alarm pull stations.

3-19.1 Outside Air Intakes, Relief Air, and Exhausts.

Provide outside air intakes, relief air, and exhaust openings with low leakage dampers that are automatically closed when the emergency air distribution shutoff switch is activated. The low leakage dampers will have maximum leakage rates of 3 cfm/square foot (15 liters/second/square meter) with a differential pressure of one inch of water gage (250 Pa) across the damper. Low leakage dampers will be located at the building envelope or as close as possible to the building envelope. If shutting down an exhaust system will violate building or fire codes or create an unsafe condition, then the exhaust system may continue to operate. For example, the installation of dampers in kitchen exhaust ductwork, where the dampers can become laden with grease, may be a violation of fire codes. Also, kitchen hood exhaust fans may have to continue to operate to avoid potential fire hazards.

3-19.2 Critical Areas.

Switch activation will not shut down HVAC systems, but will close dampers leading to the outside for systems that serve critical areas where cooling, heating, and / or airflow requirements must be maintained to prevent mission failure, or loss of data, or unsafe conditions such as computer rooms.

Switch activation will not shutdown HVAC systems and will not close dampers leading to the outside for critical systems whose continued operation is required by code or other safety protocols such as bio containment laboratories, radio isotope spaces, or other hazardous material or explosive hazard spaces.

3-19.3 Unoccupied Areas.

Switch activation may, but is not required to shutdown HVAC systems and may, but is not required to close dampers leading to the outside for systems that serve one or more normally unoccupied spaces whose access is directly to the outside such as electrical, mechanical, and fire pump rooms.

3-19.4 Fan Coil Units and Air Conditioners.

All new buildings required to comply with these standards must have a system that allows fan coil units to be shut off in an emergency. Fan coil units and air conditioners do not require low leakage dampers.

For existing inhabited buildings required to comply with these standards, emergency shutoffs for fan coil unit heaters and air conditioners are recommended.

3-20 STANDARD 19. EQUIPMENT BRACING.

For new construction and existing buildings required to comply with these standards mount all overhead utilities and other fixtures weighing 31 pounds (14 kilograms) or more (excluding distributed systems such as piping networks that collectively exceed that weight) using either rigid or flexible systems to minimize the likelihood that they will fall and injure building occupants. Design all equipment mountings to resist forces of 0.5 times the equipment weight in any horizontal direction and 1.5 times the equipment weight in the downward direction. This standard does not preclude the need to design equipment mountings for forces required by other criteria such as seismic standards.

3-21 STANDARD 20. UNDER BUILDING ACCESS.

To limit opportunities for aggressors placing explosives underneath buildings, ensure that access to crawl spaces, utility tunnels, and other means of under building access is controlled in all buildings required to comply with these standards.

3-22 STANDARD 21. MASS NOTIFICATION.

All buildings required to comply with these standards must have a timely means to notify occupants of threats and instruct them what to do in response to those threats. To achieve that goal, provide the following:

Buildings must have a capability to provide real-time information to building occupants or personnel in the immediate vicinity of the building during emergency situations. The information relayed must be specific enough to determine the appropriate response actions. The information must be capable of being originated both locally at the building and from a remote location. Design building MNS in accordance with UFC 4-021-01.

CHAPTER 4 STANDARDS FOR EXPEDITIONARY STRUCTURES

4-1 GENERAL.

Implementation of these minimum standards is mandatory for all expeditionary structures that meet the occupancy criteria for inhabited buildings. Many expeditionary structures are in forward operating locations where there is a conventional and/or terrorist threat more severe than those addressed in these standards. In those situations, more detailed planning and additional measures are needed for providing protection. Refer to the GTA 90-01-011, Joint Forward Operations Base (JFOB) Survivability and Protective Construction Handbook.

- New buildings built in expeditionary environments or existing buildings used by DoD in those environments will comply with all of the standards in Chapter 3.
- New expeditionary structures built in expeditionary environments will comply with the provisions of this chapter.

4-2 SITE PLANNING STANDARDS.

All the standards that are unique to expeditionary structures pertain to site planning. Integrate operational, logistic, and security requirements into the overall configuration of structures, equipment, landscaping, parking, roads, and other features during planning for expeditionary construction. The most cost-effective solution for mitigating explosive effects on expeditionary structures is to keep explosives as far away from them as possible. This is especially critical for these types of structures because hardening may not be possible or may be prohibitively expensive. Dispersed layouts reduce risks from a variety of threats by taking full advantage of terrain and site conditions; therefore, nothing in these standards is intended to discourage dispersal. Costs and requirements for expeditionary structure hardening are addressed in UFC 4-020-01.

4-2.1 Standard 1. Standoff Distances.

The previous version of Standard 1 established standoff distances to parking, roadways, and controlled perimeters that were based on building construction and occupancy. In this revision of Standard 1 standoff distances only apply to distances to installation perimeters for new construction and additions to existing buildings required to comply with these standards.

Exception: Existing buildings are exempt from this standard.

4-2.2 Minimum Standoff.

The minimum standoff distance for new construction and additions to existing buildings to the installation perimeter is 20 ft. (6 m). In the cases where there is no clear zone outside the perimeter, the minimum standoff distance is 50 ft. (15 m).

4-2.2.1 Clear Zone.

Standoff distances to installation perimeters are based on clear zone requirements. Clear zones are areas established around the perimeters to provide unobstructed views to enhance detection and assessment. Typically, clear zones are free of all obstacles, topographical features, and vegetation exceeding 8 in. (152 mm) in height that could impede observation or provide cover and concealment of an aggressor. Provide a minimum aggregate clear zone of 50 feet (15 m) inclusive of the clear zones outside and inside the installation perimeter. For example, if an outer clear zone is 20 ft. (6 m) wide, the standoff distance to the installation perimeter must be 30 ft. (10 m) wide. Clear zones only provide unobstructed views and do not require access control. Some forward operating locations and high security areas may have higher clear zone requirements. Consult with local antiterrorism and security personnel to determine if higher clear zones are required. See Figure 3-1 and Figure 3-2.

4-2.3 Standard 2. Structure Separation.

Structure separation requirements are established to minimize the possibility that an attack on one structure causes injuries or fatalities in adjacent structures. The separation distance is predicated on the potential use of indirect fire weapons. Structure separation also limits the ability of fire to spread from structure to structure, which is especially important in many of the types of construction used in expeditionary environments. Provide separation between structures in accordance with Figure 4-1.

4-2.4 Standard 3. Unobstructed Space.

Keep areas within 33 ft. (10 m) of all expeditionary structures free of items other than those that are part of the utilities and other supporting infrastructure. Do not allow roadways and trash containers within unobstructed spaces. Allowing parking within unobstructed spaces will be determined by security personnel.

4-3 ADDITIONAL STANDARDS.

In addition to the specific standards detailed in this chapter, apply the standards from Chapter 3 to expeditionary structures as follows:

4-3.1 Container Structures and Pre-engineered Buildings.

For these structures, all standards in Chapter 3 apply.

4-3.2 Fabric Covered, Trailers, Modular Structures, and other Expeditionary Structures.

Apply the following standards from Chapter 3 to these structures:

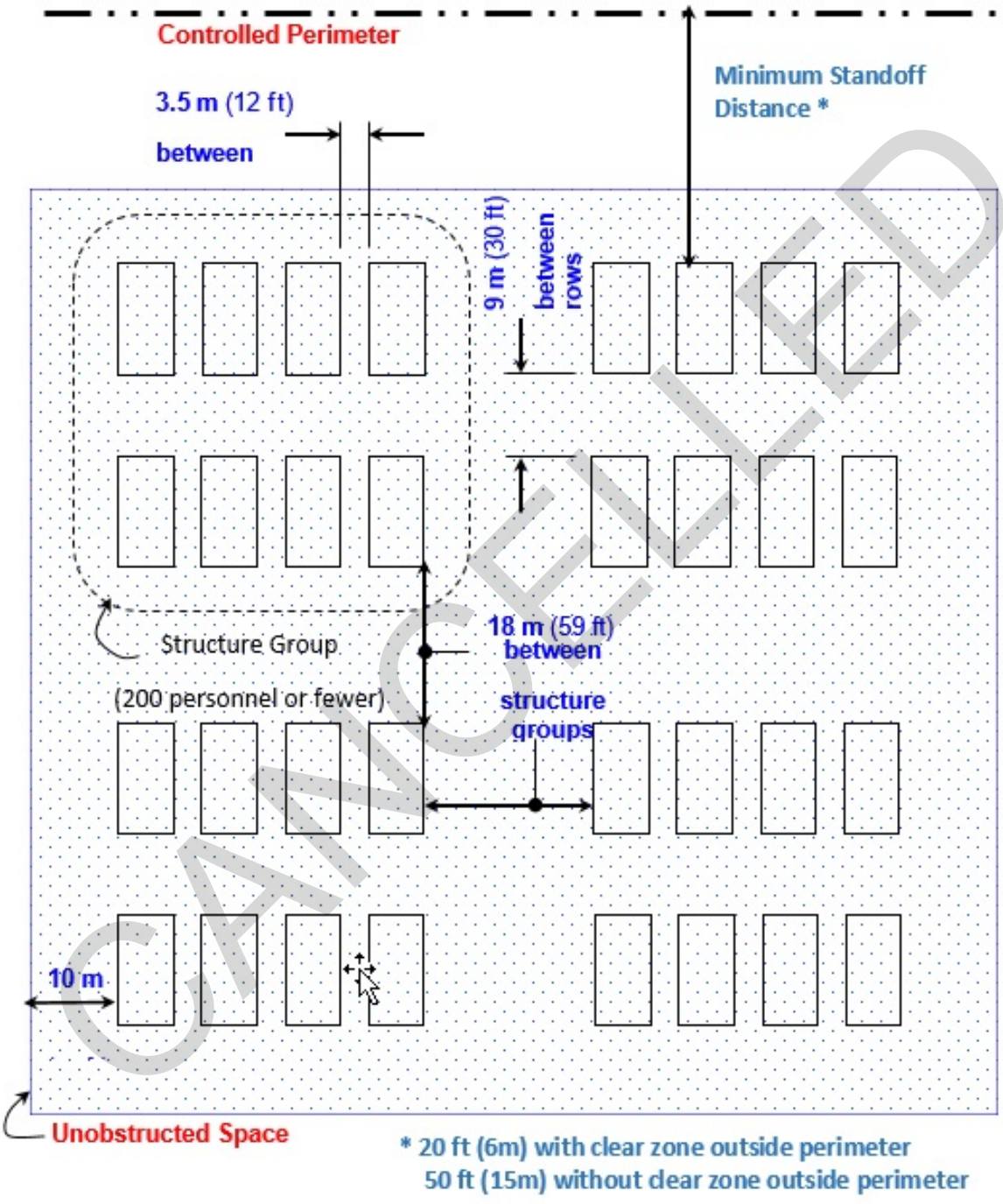
- Standard 10. Glazing
- Standard 11. Building Entrance Layout
- Standard 12. Exterior Doors

- Standard 15. Overhead Mounted Architectural Features
- Standard 19. Equipment Bracing
- Standard 21 Mass Notification

4-4 ANTITERRORISM RECOMMENDATIONS.

Apply all recommendations except for Recommendation 7 (Access control for family housing), Recommendation 8 (Standoff for family housing), and /recommendation 9 (Building Separation) from APPENDIX A to all expeditionary structures.

Figure 4-1 Standoff and Separation Distances for Expeditionary Construction



APPENDIX A RECOMMENDED ANTITERRORISM MEASURES FOR NEW AND EXISTING BUILDINGS

A-1 INTRODUCTION.

The following additional measures, if implemented, will significantly enhance building occupants' safety and security with little increase in cost and should be considered for all new and existing buildings required to comply with these standards.

A-2 RECOMMENDATION 1. VEHICLE ACCESS POINTS.

The number of access points should be kept to the minimum necessary for security and operational purposes. This will limit the number of points at which access has to be controlled at increased Force Protection Conditions or if the threat increases in the future.

A-3 RECOMMENDATION 2. HIGH-SPEED VEHICLE APPROACHES.

The energy of a moving vehicle increases with the square of its velocity; therefore, minimizing a vehicle's speed enables the vehicle barriers used to be lighter and less expensive. To facilitate vehicle speed reduction, avoid unobstructed vehicle approaches that create direct paths to buildings.

A-4 RECOMMENDATION 3. DRIVE-UP/DROP-OFF AREAS.

Drive-up and drop-off areas should be located away from large glazed areas of buildings to minimize the potential for hazardous flying glass fragments in the event of an explosion. Consider locating the lanes at outside corners of buildings or otherwise away from main entrances or minimizing glazing in the proximity of drive-up and drop-off areas. Building geometries such as reentrant corners in the vicinity of drive-up and drop-off areas should be laid out to minimize the possibility that explosive blast forces could be increased due to being trapped or otherwise concentrated.

A-5 RECOMMENDATION 4. BUILDING LOCATION.

Activities with large visitor populations provide opportunities for potential aggressors to get near buildings with minimal controls and limit opportunities for early detection of aggressor activity. To limit opportunities for aggressors, separation distances should be maximized between buildings required to comply with these standards and areas with large visitor populations.

A-6 RECOMMENDATION 5. RAILROAD LOCATION.

For new construction avoid sites for buildings that are close to railroads. For existing buildings, procedures should be in place to prohibit trains from stopping in the vicinity of those buildings.

A-7 RECOMMENDATION 6. ACCESS CONTROL FOR FAMILY HOUSING.

For new family housing areas, allocate space at the perimeter of the housing area for an entry control facility/access control point designed in accordance with UFC 4-022-01 may be established if the need arises.

A-8 RECOMMENDATION 7. STANDOFF FOR FAMILY HOUSING.

For new low occupancy family housing construction, standoff distances should be maintained in accordance with the Standard 1.

A-9 RECOMMENDATION 8. BUILDING SEPARATION.

For all new construction, buildings should be separated from adjacent buildings by at least 33 feet (10 meters).

This recommendation applies to new buildings and is established to minimize the possibility that an attack on one building causes injuries or fatalities in adjacent buildings.

A-10 RECOMMENDATION 9. VISITOR CONTROL.

Controlling visitor access maximizes the possibility of detecting potential threatening activities. Locations in buildings where visitor access is controlled should be kept away from sensitive or critical areas, areas where high-risk or mission-critical personnel are located, or other areas with large population densities of DoD personnel.

A-11 RECOMMENDATION 10. ASSET LOCATION.

To minimize exposure to direct blast effects and potential impacts from hazardous glass fragments and other potential debris, critical assets and mission-critical or high-risk personnel should be located away from the building exterior.

A-12 RECOMMENDATION 11. ROOM LAYOUT.

In rooms adjacent to the exterior of the building, personnel and critical equipment should be positioned to minimize exposure to direct blast effects and potential impacts from hazardous glass fragments and other potential debris.

A-13 RECOMMENDATION 12. EXTERNAL HALLWAYS.

Because doors can become hazardous debris during explosive blast events and designing them to resist blast effects is expensive, avoid building configurations that have large numbers of exterior doors leading into inhabited areas in buildings required to comply with these standards. A common example is a barracks/dormitory with exterior doors into each room or suite. Internal hallways with interior entrances to rooms or suites are preferable.

APPENDIX B BEST PRACTICES

B-1 INTRODUCTION.

The contents in this appendix are not required. The contents in this appendix are taken from the previous publication of this UFC to retain until publication of UFC 4-020-02. The information contained within may be used when a specific threat has been identified for the location or project based on UFC 4-020-01 or Service, Agency, or Geographic Combatant Command guidance.

This appendix presents a best practices strategy for site planning and designing facilities to protect against stationary vehicle bombs and hand delivered devices.

B-2 SITE PLANNING FOR STATIONARY VEHICLE BOMBS AND HAND DELIVERED DEVICES.

Protective measures associated with site planning are established to address vehicle borne and hand placed explosive threats. The most cost-effective solution for mitigating explosive effects on buildings is to keep explosives as far as possible from them. Standoff distance should be coupled with appropriate building hardening to provide the necessary level of protection to DoD personnel as described in Table B-1.

Where conventional construction standoff distances cannot be achieved because land is unavailable, these best practices allow for building hardening to mitigate the blast effects. Planning level costs and requirements for building hardening are addressed in UFC 4-020-01. None of these best practices address physical barriers that are capable of stopping moving vehicles to prevent vehicles from accessing areas within the standoff distances established below. Measures using landscaping features, curbing, or pavement marking should meet the best practices for establishing standoff below. Those features address what is called the Stationary Vehicle Bomb Tactic in which the aggressor is assumed not to attempt to enter into areas where he or she would be noticed. Considerations for the Moving Vehicle Bomb Tactic where in the aggressor may be suicidal would include barriers that are capable of stopping the kinetic energy of the threat vehicle. For further discussion on both tactics, refer to UFC 4-020-01.

B-2.1 Standoff Distances.

Provide standoff distances between buildings and controlled perimeters, parking areas, roadways, and trash containers. The standoff distances are presented in Appendix C and illustrated in Figure B-1 and Figure B-2 for new buildings and Figure B-3 and Figure B-4 for existing buildings. For planning purposes, standoff distance is measured to the closest point on the building exterior. Vehicle barriers are not required to maintain these standoff distances unless threat analysis justifies them.

B-2.1.1 Standoff Analysis.

Where the standoff distances in the “Conventional Construction Standoff Distance” (CCSD) columns of Table C-1 through Table C-4 can be met, conventional construction for the applicable building walls may be used for the buildings without a specific analysis

of blast effects. Roofs do not need to be analyzed where the standoff distances for roofs in Table C-1 through Table C-4 are met and where they are within the ranges of one of the roof construction types in Table C-5. Types of construction not shown in Table C-5 may be permissible subject to validation by the designer of record. While the Appendix C tables address windows, the standoff distances shown should only be used for planning purposes as indicators of standoff distances at which conventionally constructed windows can be used. Standoff Distances for expeditionary structures are found in Table C-6.

Where conventional construction standoff distances are not available, lesser standoff distances may be validated through analysis that verifies the applicable level of protection is met, but none may be closer than the minimum standoff distance distances described in paragraph B-2.1.3 except as allowed for existing buildings. Allowable building damage and door and window hazards for the various levels of protection are described in Table B-1. Note that regardless of standoff distance, where buildings are three stories or more, the progressive collapse provisions of Standard 6 should be applied.

Figure B-1 Standoff Distances – With Controlled Perimeter

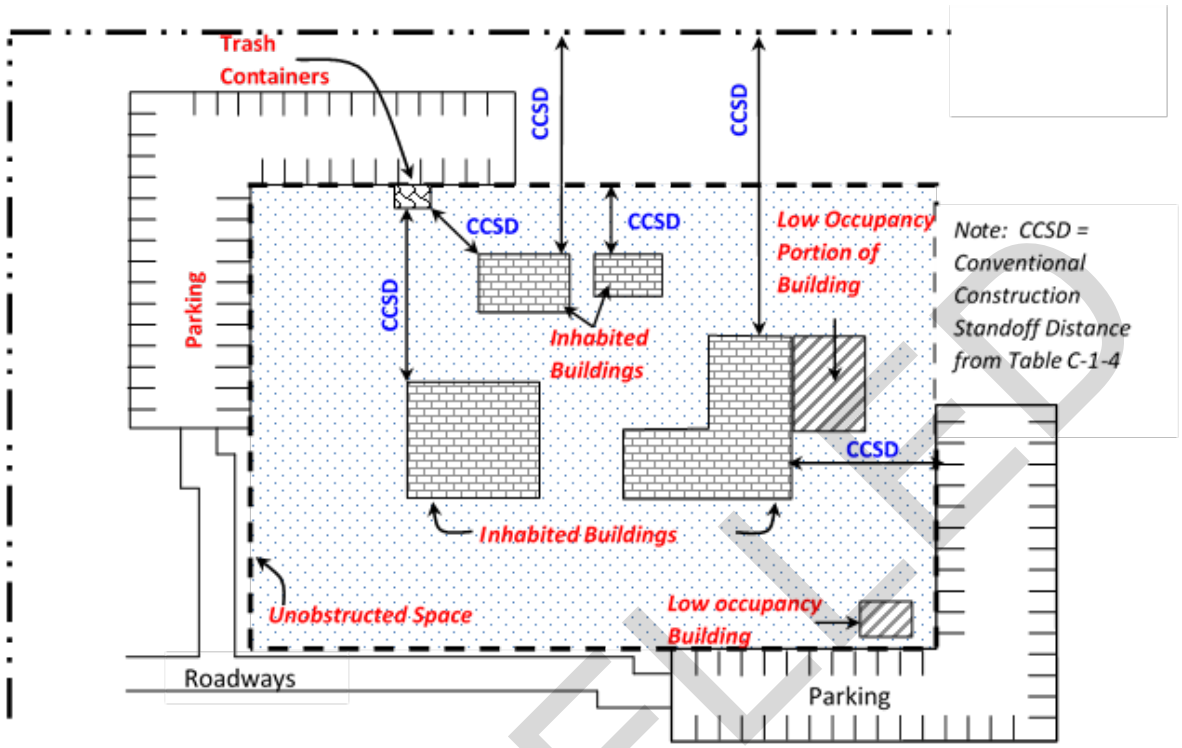


Figure B-2 Standoff Distances – No Controlled Perimeter

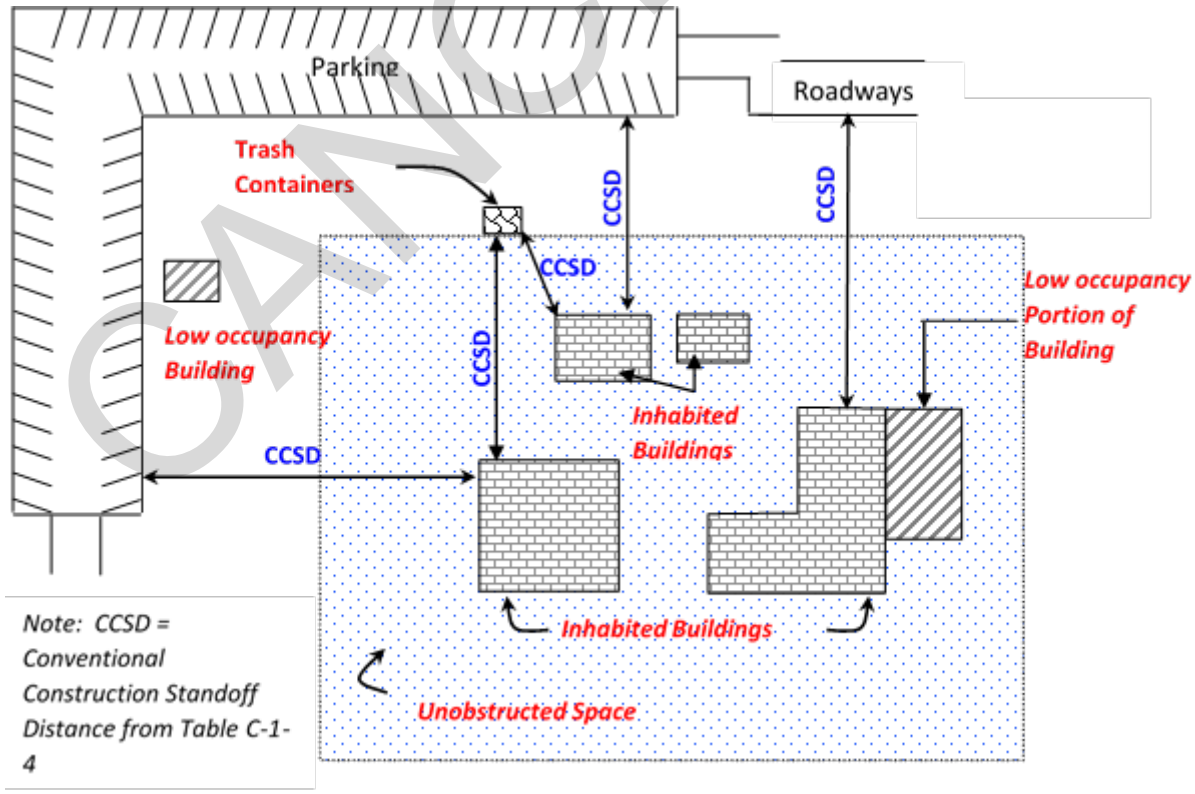


Figure B-3 Parking and Roadway Control for Existing Buildings – Controlled Perimeter

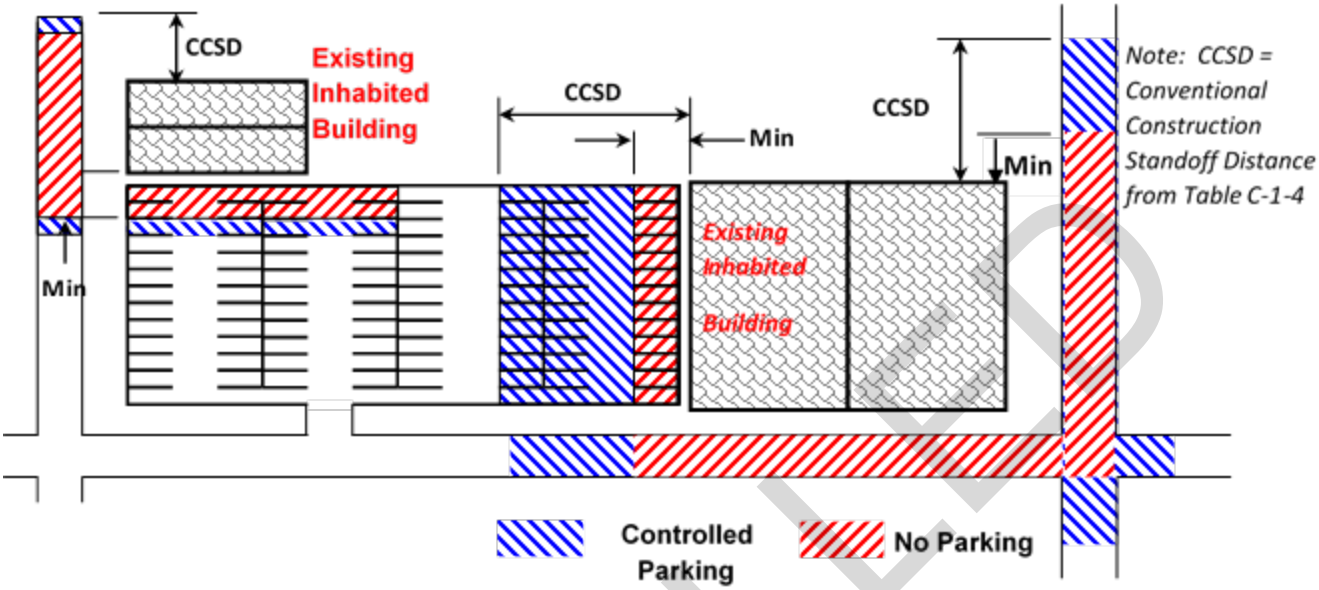
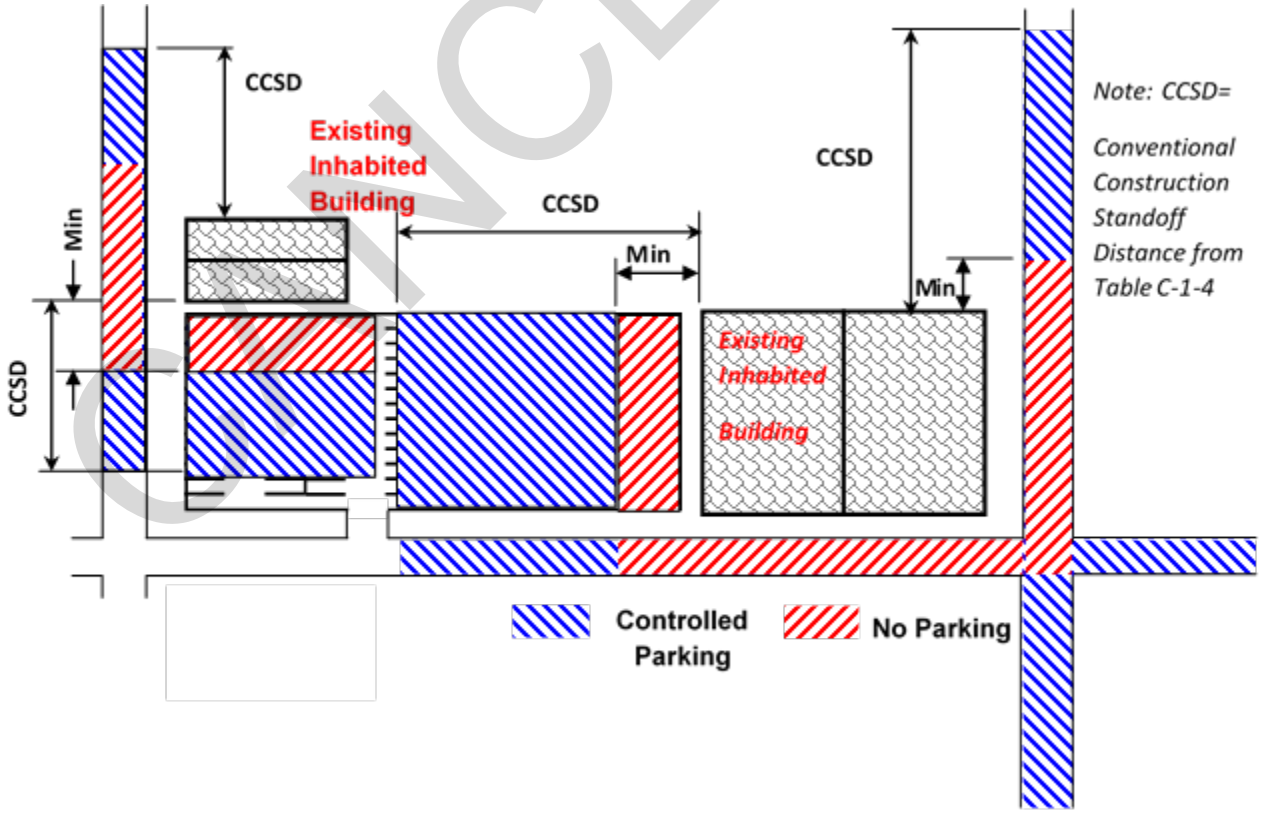


Figure B-4 Parking and Roadway Control for Existing Buildings – No Controlled Perimeter



B-2.1.2 Conventional Construction Standoff Distance.

Standoff distances for buildings vary based on the specific construction of the walls, on whether they are load bearing or non-load bearing, by level of protection, and by explosive weight. The specific construction types upon which the standoff distances are based are indicated in Table C-1 through Table C-4 and detailed descriptions of their design parameters are tabulated in Table C-5. The separate conventional construction standoff distances columns in Table C-1 through Table C-4 for load bearing and non-load bearing wall construction reflect the fact that the damage allowed to load bearing construction is less than that allowed to non-load bearing construction for the same level of protection as explained in PDC Technical Report 06-08. Specific standoff distances are tabulated for different construction types. Note that the conventional construction standoff distance columns in Table C-1 through Table C-4 are primarily related to walls because the walls in that table always controlled the conventional construction standoff distance over any of the roofs indicated in Table C-5. Walls and roofs of construction other than those included in Table C-5 should be designed to provide the applicable response described in Table B-1 and detailed in PDC Technical Report 06-08. Standoff distances for windows in Table C-1 through Table C-4 are for conventional windows. When standoff distances are closer than those standoff distances windows will commonly be much heavier and more expensive than conventional windows.

Conventional construction standoff distances do not apply to doors; refer to B-3.2. Planners and designers will have to analyze tradeoffs between wall standoff and window and door construction. Standoff distances for expeditionary structures are based on structure types as indicated in Table C-6.

B-2.1.3 Minimum Standoff Distance.

Minimum standoff distance is the smallest permissible standoff distance allowed for buildings regardless of any analysis results or hardening of buildings that would allow for closer standoff distances, except as established below for existing buildings. Note that achieving the minimum standoff distance generally requires a significant degree of building component hardening; therefore, where only the minimum standoff distance is provided there should be analysis results that show it can be achieved while still providing the applicable level of protection. Minimum standoff distance R_M is determined as a scaled range of 3 by the following equations:

$$\text{For Feet: } R_M = 3\sqrt[3]{W}$$

$$\text{For Meters: } R_M = 1.19\sqrt[3]{W}$$

Where:

W is the threat explosive weight in pounds for feet or kilograms for meters.
R_M is the minimum standoff distance in feet or meters.

Table B-1 Levels of Protection – New and Existing Buildings

Level of Protection	Potential Building Damage/Performance [2]	Potential Door and Glazing Hazards[3,4]	Potential Injury
Below AT standards[1]	Severe damage. Progressive collapse likely. Space in and around damaged area will be unusable.	* Windows will fail catastrophically and result in lethal hazards. *(High hazard rating)* * Doors will be thrown into rooms. *(Category V)*	Majority of personnel in collapse region suffer fatalities. Potential fatalities in areas outside of collapsed area likely.
Very Low	Heavy damage - Onset of structural collapse, but progressive collapse is unlikely. Space in and around damaged area will be unusable.	* Glazing will fracture, come out of the frame, and is likely to be propelled into the building, with potential to cause serious injuries. *(Low hazard rating)* * Doors will become dislodged from the structure but will not create a flying debris hazard. *(Category IV)*	Majority of personnel in damaged area suffer serious injuries with a potential for fatalities. Personnel in areas outside damaged area will experience minor to moderate injuries.
Low	Moderate damage – Building damage will not be economically repairable. Progressive collapse will not occur. Space in and around damaged area will be unusable.	* Glazing will fracture, potentially come out of the frame, but at reduced velocity, does not present a significant injury hazard. *(Very low hazard rating)* * Doors will experience non-catastrophic failure, but will have permanent deformation and may be inoperable. *(Category III)*	Majority of personnel in damaged area suffer minor to moderate injuries with the potential for a few serious injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience minor to moderate injuries.
Medium	Minor damage – Building damage will be economically repairable. Space in and around damaged area can be used and will be fully functional after cleanup and repairs.	* Glazing will fracture, remain in the frame and results in a minimal hazard consisting of glass dust and slivers. *(Minimal hazard and No Hazard ratings)* * Doors will be openable but will have permanent deformation. *(Category II)*	Personnel in damaged area potentially suffer minor to moderate injuries, but fatalities are unlikely. Personnel in areas outside damaged areas will potentially experience superficial injuries.
High	Minimal damage. No permanent deformations. The facility will be immediately operable.	* Innermost surface of glazing will not break. (No Break hazard rating) * Doors will be substantially unchanged and fully operable. *(Category I)*	Only superficial injuries are likely.

1. This is not a level of protection and should never be a design goal. It only defines a realm of more severe structural response, and may provide useful information in some cases.
2. For damage / performance descriptions for primary, secondary, and non-structural members, refer to PDC Technical Report 06-08.
3. Glazing hazard ratings are from ASTM F 2912.
4. Door damage level categories are from ASTM F 2247 and F 2927.

For new buildings, standoff distances of less than a scaled range of 3 should not be allowed. For existing buildings, the minimum standoff distances should be provided except where doing so is not possible. In those cases, lesser standoff distances may be allowed where the applicable level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit as described in these standards

B-2.1.4 Distances Between Conventional and Minimum Standoff Distances

Where the conventional construction standoff distances are not available, an engineer experienced in blast-resistant design should analyze the building and apply building hardening as necessary to mitigate the effects of the applicable explosives at the achievable standoff distance to the appropriate level of protection. The appropriate levels of protection are described in Table B-1 and in UFC 4-020-01. Detailed design parameters for meeting the levels of protection are in PDC Technical Report 06-08. Buildings should be designed for fully reflected blast pressures except where it can be proven that a wall could never be exposed to reflected pressures.

B-2.1.5 Parking and Roadways Standoff Distances.

Measure the standoff distance from the closest edge of parking areas, driving lanes within parking areas, and roadways to the closest point on the building exterior or inhabited portion of the building or to specific building components. In addition, the following apply:

B-2.1.5.1 New Buildings.

The minimum standoff distance for all new buildings regardless of hardening or analysis is that associated with a scaled range of 3 for both parking areas and roadways, whether parking is allowed on the roadways or not.

B-2.1.5.2 Existing Buildings.

Where possible, move parking and roadways away from existing buildings in accordance with the standoff distances in Table C-1 through Table C-4 for the threat explosive weight and the applicable level of protection. It is recognized that moving existing parking areas and roadways or applying structural retrofits may be impractical in some cases; therefore, the following operational options are provided for existing buildings.

a. Controlled Parking Areas.

Controlled parking associated with existing buildings may be allowed to be as close as the minimum standoff distance without hardening or analysis if access control (see definition in glossary) to the parking area is established at the applicable conventional construction standoff distance for parking. In cases where the applicable level of protection can be provided (based on hardening or analysis) with a standoff distance between the conventional construction standoff distance and the minimum standoff distance, uncontrolled parking may be allowed at the standoff distance at which the

level of protection can be achieved subject to the requirements below, but not closer than the minimum standoff distance.

To mitigate the introduction of hand delivered explosives into the controlled parking areas in violation of the unobstructed space standard (Standard 2), controlled parking areas should have some means to control pedestrian access as well as vehicular access, such as fencing or walls.

b. Driving Lanes within Parking Areas.

Where limited space necessitates, driving lanes within parking areas may be closer to existing buildings than parking spaces located at the applicable standoff distances, but vehicles should not be left unattended in those driving lanes. Standoff distance in these cases should be to the nearest parking space. This should not be allowed for new buildings.

c. Alternate Situations.

Parking may be closer to existing buildings than the minimum standoff distance where it is impractical to achieve that distance and where it can be shown through analysis that the applicable level of protection can be provided at the lesser standoff distance or if it can be provided through building hardening or other mitigating measures or retrofits designed for those standoff distances. Allowing any parking closer than the distances established in the paragraphs above should be avoided wherever possible.

d. Parking on Existing Roadways.

Parking along roadways is subject to similar standoff considerations as to other parking. Where there are existing roads adjacent to existing inhabited buildings, ensure there is no parking on those roadways closer than the conventional construction standoff distance unless the applicable level of protection can be provided (based on hardening or analysis) with a standoff distance between the conventional construction standoff distance and the minimum standoff distance. Parking along those roadways should not be closer than the minimum standoff distance under any circumstance. (Refer to Figure B-3 and Figure B-4). Where parking along existing roadways adjacent to existing buildings can be controlled, parking may be allowed to be as close as the minimum standoff distance without hardening or analysis.

e. Parking for Existing High Occupancy Family Housing.

For existing high occupancy family housing within a controlled perimeter or where there is access control to the parking area, parking within the required standoff distances may be allowed where designated parking spaces are assigned for specific residents or residences. Do not label assigned parking spaces with names or ranks of the residents. Where the existing standoff distances are less than the required standoff distances do not encroach upon those existing standoff distances with any additional parking. Avoid parking closer than the minimum standoff distance.

B-2.1.5.3 Adjacent Underground Parking.

Where underground parking is provided adjacent to (not underneath) buildings, parking may be allowed as close to the buildings as the construction of the building superstructure will allow based on the applicable level of protection and explosive weight. Analysis should show that the soil-structure interaction and any venting into the building will not cause progressive collapse of the building or damage to inhabited areas of the building beyond the applicable level of protection. Also, ensure there is no venting into inhabited areas of buildings that could result in occupant injuries.

B-2.1.5.4 Government Vehicle Parking.

Limitations on parking near buildings apply to all vehicles, including official and tactical vehicles, except for mobile ground tactical platforms, emergency vehicles, and operations support vehicles that are never driven out of restricted access areas, as established in these best practices. Government vehicles other than those vehicles are included in the parking limitations in these best practices because it is assumed that when they are out of restricted access areas they may be out of the immediate control of their operators, which could make them susceptible to having explosives placed on or inside of them.

B-2.1.5.5 Parking of Emergency, Command, and Operations Support Vehicles.

Emergency and command vehicles, as well as operations support vehicles may be parked closer to buildings than allowed in Table C-1 through Table C-4 without hardening or analysis if access to the vehicles is continuously controlled or as long as they are never removed from a restricted access area. Command and operations support vehicles should not be parked closer than the applicable minimum standoff distance. In addition, where standard operation of buildings includes parking emergency vehicles inside them, such as in fire stations, those emergency vehicles may be parked inside the buildings.

Emergency vehicles and command vehicles are exempted from parking restrictions because they are assumed to be under strict control while they are both in and away from their usual parking spaces. Operational support vehicles are exempted because they are assumed to always operate within restricted access areas such as airfields.

B-2.1.5.6 Parking of Vehicles Undergoing Maintenance.

Vehicles undergoing maintenance may be parked inside maintenance buildings close to inhabited areas of those buildings while they are undergoing repair without providing any hardening or analysis of the buildings. Vehicles stored outside awaiting maintenance are subject to the parking limitations in these best practices.

B-2.1.5.7 Parking of Mobile Ground Tactical Platforms.

Where operational requirements require parking mobile ground tactical platforms containing non-removable sensitive compartmented information systems adjacent to buildings, ensure those parking areas are surrounded by a 7 foot (2 meter) chain link security fence topped by a single outrigger with three-strands of barbed wire and that

access to those parking areas is controlled so that the vehicles cannot be accessed without being detected.

Mobile ground tactical platforms are exempted because they are provided strict security and access control due the sensitive nature of their missions and because they must be parked adjacent to buildings to support their connectivity for electronic system updates.

B-2.1.5.8 Parking for Handicapped Personnel.

Parking for handicapped personnel should not be located closer than the standoff distances necessary to meet the applicable levels of protection. Handicapped parking is only required to be the closest parking available. There is no set distance associated with it.

B-2.1.5.9 Parking and Roadway Projects.

Where practical, all roadway and parking area projects not associated with a building renovation, modification, repair, or restoration should comply with the applicable conventional construction standoff distances from existing inhabited buildings. Where parking areas that are within the applicable standoff distances from such existing buildings are being constructed, expanded, or relocated, those parking areas should not encroach on the existing standoff distances of any existing inhabited building unless it can be shown that the building can provide the appropriate level of protection that would apply if the building were required to meet a standoff distance. Parking and roadway projects should not be located closer than the applicable minimum standoff distances.

If roadway projects include road widening or encroachment on existing standoff distances is otherwise unavoidable, ensure there are operational procedures in place to prohibit parking on the roadways within those standoff distances as described in paragraph B-2.1.5.2. Driving lanes within parking areas may be allowed to be closer to existing buildings than the closest parking spaces where limited space necessitates, but vehicles may not be left unattended in those driving lanes.

B-2.1.5.10 Standoff to Entry Control Facilities/Access Control Points.

For stationary vehicle bomb threats standoff distances from buildings to Entry Control Facilities/Access Control Points should be measured from the identification check area to the closest point on the building exterior or inhabited portion of the building or to specific building components. For moving vehicle bomb threats standoff distances should be measured to the nearest final denial active vehicle barrier.

B-2.1.5.11 Location of Trash Containers.

Provide standoff distances from the nearest points of trash containers or trash container enclosures to the closest points on building exteriors, inhabited portions of buildings, or to specific building components in accordance with the conventional construction standoff distance for the threat hand carried explosive. Where the applicable conventional construction standoff distance is not available, analyze the building and apply building hardening as necessary to mitigate the effects of the applicable explosives for trash containers at the achievable standoff distance to the appropriate level of protection.

Alternatively, harden trash enclosures to mitigate the direct blast effects and secondary fragment effects of the explosive on the building if the applicable level of protection can be proven by analysis or testing. As an additional alternative, if trash containers or enclosures are secured to preclude introduction of objects 6-in. (150 mm) or greater in height or width into them by unauthorized personnel, they may be located closer to the building as long as they do not violate the unobstructed space provisions of paragraph B-2.2. Openings in screening materials and gaps between the ground and screens or walls making up an enclosure should not be greater than 6 in. (150 mm).

B-2.1.5.12 Adjacent Existing Buildings.

Where projects for new and existing buildings include locating parking, roadways, or trash containers near existing inhabited buildings, the standoff distances from parking, roadways, and trash containers to those buildings should comply with the applicable standoff distances in Table C-1 through Table C-4.

Where those standoff distances are not available, do not allow parking and roadways to encroach on existing standoff distances to parking and roadways associated with those existing buildings unless it can be shown that the building can provide the appropriate level of protection that would apply if the building were required to comply with the minimum standards in this UFC. The encroachment provision above applies only to parking and roadways. Do not allow trash containers associated with new or existing buildings to be located closer to existing inhabited buildings than the applicable standoff distances in Table C-1 through Table C-4.

B-2.1.5.13 Parking Structures.

Standoff distances between parking structures and inhabited buildings should be measured to actual parking spaces within the parking structures, including spaces on all floors of the parking structures.

B-2.2 Unobstructed Space.

Standard 2 covers unobstructed space requirements to meet the minimum standards, however, fully mitigating the effects of a hand placed explosive requires determining a standoff distance based on the building construction, threat explosive weight, and applicable level of protection. To achieve that mitigation, do the following in addition to what is required by Standard 2. The unobstructed space should extend out to the

applicable conventional construction standoff distance to walls for parking and roadways in accordance with Table C-1 through Table C-4, but not less than the minimum standoff distance. If the standoff distance required to provide the applicable performance of windows or doors is greater than the conventional construction standoff distance, the unobstructed space should extend to the applicable window or door distance. Unobstructed space for expeditionary structures should be determined using Table C-6.

Alternatively, for distances between the conventional construction standoff distance and the minimum standoff distance, standoff distances may be validated through analysis. That analysis verifies the applicable level of protection is met based on mitigating the effects of the threat hand carried explosive at the distance between the location of the explosive and the area of the building being protected. For existing buildings where the standoff distances for parking and roadways have been established at less than the minimum standoff distance, the unobstructed space may be reduced to be equivalent to those distances.

B-2.2.1 Controlled Parking.

Where controlled parking associated with existing buildings is allowed, the unobstructed space should be considered to extend to the limits of those parking areas where access is controlled. To mitigate the introduction of hand delivered explosives into the controlled parking areas, those areas should have some means to control pedestrian access as well as vehicular access, such as fencing or walls. Security fences or walls should be a minimum of 7 ft. (2 m) high. Specific fence, wall, and access control requirements should be coordinated with physical security and antiterrorism personnel.

B-2.2.2 Parking Within Unobstructed Spaces.

When an explosive threat has been identified, parking should not be allowed within unobstructed spaces except for parking of emergency, command, and operations support vehicles and mobile ground tactical platforms.

B-2.2.3 Adjacent Uncontrolled Public Space.

Where there is a defined explosive threat and there are spaces with uncontrolled public access below, above or beside building areas that are occupied by DoD, it should be considered that the threat explosives may be located in those spaces and the spaces occupied by DoD should be designed to ensure that they meet the applicable level of protection

B-2.3 Drive-Up/Drop-Off Areas.

Some facilities require access to areas within the required standoff distances for dropping off or picking up people or loading or unloading packages and other objects. Examples that may require drive-ups or drop-offs include, but are not limited to, medical facilities, exchanges and commissaries, schools, and child care centers. In these cases, standoff distances should be measured to the nearest legal parking spaces, not the drive-ups or drop-offs. No building hardening should be required to compensate for

the closer standoff distances associated with the drive-ups or drop-offs. This also applies to drive-through lanes such as those at stand-alone franchised food operations.

B-2.3.1 **Marking.**

Where operational or safety considerations require drive-up or drop-off areas or drive-through lanes near, ensure those areas or lanes are clearly defined and marked in accordance with the Manual on Uniform Traffic Control Devices and that their intended use is clear to prevent parking of vehicles in those areas.

B-2.3.2 Unattended Vehicles.

Do not allow unattended vehicles in drive-up or drop-off areas or drive-through lanes. Prohibit unattended vehicles within conventional construction standoff distances in accordance with Table C-1 through Table C-4 or ensure through analysis that buildings can provide the appropriate level of protection at lesser standoff distances. Unattended vehicles should never be allowed closer than the minimum standoff distance.

B-2.3.3 Location.

Do not allow drive-through lanes or drive-up/drop-off areas to be located under any inhabited portion of any new building. For existing buildings that have drive-through lanes or drive-up areas, either eliminate them or design the buildings to provide the applicable level of protection for the applicable explosive weight located underneath the portion of the building accessed by the drive-through or drop-off.

B-2.4 Access Roads.

Where access roads are necessary for the operation of buildings (including those required for emergency access and/or security operations), ensure that access control measures are implemented to prohibit unauthorized vehicles from using access roads within the applicable standoff distances. Because situations at various buildings and installations are different, the development of specific access control measures and procedures is beyond the scope of these standards. That is left to local physical security personnel.

B-2.5 Parking Beneath Buildings or on Rooftops.

Standard 5 in Chapter 3 establishes the minimum measures required for addressing this situation. To mitigate the effects of an explosive event underneath or on top of a building, ensure that there is no general collapse of more than one single bay of floor beneath or floors/roof above inhabited areas and that all other adjacent supporting structural elements will not fail from the detonation in the parking area of the threat explosive. Unless it can be shown that a greater standoff distance can be justified, evaluate structural elements in parking areas at a standoff distance of 4 ft. (1.2 m) horizontally or 30 in. (76 cm) above the elements. Failure should be evaluated based on the applicable level of protection in accordance with PDC Technical Report 06-08. Also, ensure there is no venting into inhabited areas of buildings that could result in

occupant injuries. In addition, see Standard 6 of the minimum standards for progressive collapse avoidance requirements.

B-3 ARCHITECTURAL AND STRUCTURAL DESIGN.

Chapter 3 establishes minimum requirements for glazing and doors. Those requirements do not address mitigation of blast effects on structures. Where an explosive threat has been identified to a facility, the following apply.

B-3.1 Windows and Skylights.

To minimize hazards from flying debris from windows and skylights, apply the following provisions for glazing, framing, connections, and supporting structural elements for all new and existing buildings for which there is an identified explosive threat. These provisions apply to window systems at all standoff distances, even those that meet or exceed the wall conventional construction standoff distances. The specific requirements below will result in window and skylight systems that provide for effective hazard mitigation. These provisions allow for design by dynamic analysis, testing, or the ASTM F 2248 design approach as described in the paragraphs below. Use strength design with load factors of 1.0 and strength reduction factors of 1.0 for all methods of analysis referenced herein for flexure and use typical strength reduction factors for other modes of failure. Windows will be inclusive of storefronts, clerestories, and similar glazed construction. For glazed doors refer to paragraph B-3.2.2.

Monolithic glass or monolithic acrylic used as a single pane or as the inner pane of a multi-pane system should not be allowed as glazing when there is an identified explosive threat. Spandrel glass when backed by a structural wall or spandrel beam, translucent fiberglass panels, other lightweight translucent plastics, and glass unit masonry should meet the performance requirements of Table B-1. That performance needs to be proven through testing or analysis. Engineered glass block window systems and spandrel glass that is open to occupied space should be designed in accordance with the following guidance.

B-3.1.1 Dynamic Analysis.

Any of the glazing, framing members, connections, and supporting structural elements may be designed using dynamic analysis to prove the window or skylight systems will provide performance equivalent to or better than the hazard rating associated with the applicable level of protection established in the project requirements and described in Table B-1. Dynamic analysis guidance is presented in PDC TR 10-02. The design loadings for dynamic analyses should be the appropriate pressures and impulses from the applicable explosive weights at the actual standoff distances at which the windows are sited. The design loading should be applied over the areas tributary to the element being analyzed. The allowable response limits of structural elements for all of the levels of protection are provided in PDC-TR 06-08. Response limits for steel and aluminum window frame members are provided in PDC-TR-10-02. Window frames constructed from materials other than aluminum or steel should be tested in accordance with paragraph B-3.1.2 or proven by analysis to demonstrate performance equivalent to or

better than the hazard rating associated with the applicable level of protection as indicated in Table B-1.

B-3.1.2 Testing.

Window and skylight systems may be dynamically tested to demonstrate performance equivalent to or better than the hazard rating associated with the applicable level of protection as indicated in Table B-1. Testing should include the entire window or skylight system, including connections, and should be in accordance with ASTM F 1642 with hazard ratings in accordance with ASTM F 2912.

The structural supporting material used in the test for fastener attachment should be representative of the fielded application. Any deviations in field application of the connections or the connected elements from the test should be demonstrated by calculation to provide the applicable level of protection for the specific application. The design loading for a dynamic test should be the appropriate pressure and impulse from the applicable explosive weight at the actual standoff distance at which the window is sited.

B-3.1.3 ASTM F 2248 Design Approach for Laminated Glass Glazing Systems.

Windows and skylights fabricated using laminated glass may be designed using ASTM F 2248 and ASTM E 1300 in accordance with the requirements below. The application of ASTM F 2248 and ASTM E 1300 results in a medium level of protection as reflected in Table B-1.

B-3.1.3.1 Glazing.

Provide laminated glass with a minimum interlayer thickness of 0.030 in. (0.75mm) and a load resistance determined from ASTM E 1300 greater or equal to the 3-second duration equivalent design load determined from ASTM F 2248.

Note that ASTM F 2248 can be used for a limited range of charge weights and standoffs, including those covered by this standard. For charge weights and standoffs outside of the range of ASTM F 2248, for conditions outside the range of ASTM E 1300, and for glazing alternatives to laminated glass that provide equivalent levels of protection, refer to PDC Technical Report 10-02.

B-3.1.3.2 Frames.

Provide window and skylight frames, mullions and sashes of aluminum or steel designed in accordance with ASTM F 2248. Window frames constructed from materials other than aluminum or steel should be tested in accordance with paragraph B-3.1.2 or proven by analysis to demonstrate performance equivalent to or better than the hazard rating associated with the applicable level of protection as indicated in Table B-1.

In the case of a punched or ribbon window, the supported edge length should be taken as equal to the longest span of a single pane of glass, regardless of any intermediate

support connections. For storefront and curtain wall systems, primary mullions that span between points of structural support should be considered supporting frame members and may be designed dynamically in accordance with paragraph B-3.1.1 or statically. If designed by the static method the moment and shear capacities of framing members should be designed to resist two (2) times the glazing resistance applied to the framing members only from the tributary area of the window, and deflection should be limited to 1/60 of the members' span lengths between points of structural support. Intermediate mullions should be checked for deflection with the supported edge length taken as equal to the longest span of a single glass panel and the deflection should be calculated based on simple support conditions for that length.

B-3.1.3.3 Glazing Frame Bite.

Glazing frame bite requirements for structurally or non-structurally glazed windows or skylights should be in accordance with ASTM F 2248. Apply structural silicone bead or glazing tape to both sides of the glass panel for single pane glazing but only to the inboard side for insulating glass units.

B-3.1.3.4 Connection Design.

Connections of window and skylight frames to surrounding walls or roofs, of hardware and associated connections, of glazing stop connections, and of other elements in shear should be designed for the connection design load determined in accordance with ASTM F 2248 and should account for the geometry of the particular frame and the connection configuration being used when calculating bending, shear, bearing, and pull out loads for the connections.

B-3.1.4 Design of Supporting Structural Elements.

Supporting structural elements (i.e. those structural elements that frame the rough opening) for window and skylight systems of any glazing material can be designed statically to account for the increase in tributary areas to the adjacent supporting elements due to windows or skylights. Building elements that have only glazing framed into them, such as curtain walls and storefronts, should be designed as frame members in accordance with paragraph B-3.1.3.2. For window and skylight systems in buildings situated at less than the wall conventional construction standoff distance, the surrounding wall and roof elements should be designed dynamically in accordance with paragraph B-3.1.1.

B-3.1.4.1 Static Design of Wall and Roof Elements.

For window and skylight systems in buildings situated at or beyond the wall conventional construction standoff distance for the wall material to which it is attached, the surrounding wall and roof elements and their connections to the rest of the structure should be designed as described below. The supporting structural elements adjacent to windows should be designed to account for their increased tributary areas. These areas represent the tributary areas of windows or skylights, and the walls or roof area above and below them, whose loads should be laterally supported by those elements. Those

increases in tributary areas should be accounted for by applying a tributary area increase factor (C) to the moment and shear capacities of the walls. The tributary area increase factor is the ratio of the tributary area that accounts for the windows or skylights and the walls or roofs above and below them to the tributary area upon which typical conventional wall sections or elements are designed. See PDC Technical Report 10-02 for an illustration. The tributary area increase factor is shown in Equation 1 and should not be taken as less than 1.

$$C = \frac{a_{trib}}{a_{wall}} \geq 1$$ Equation 1

a wall = tributary area for typical conventional wall section or element

a trib = combined tributary area for supported window or skylight and wall or roof section or element

Design the supporting structural elements to have moment and shear capacities equal to or greater than the calculated conventional wall capacities multiplied by the applicable tributary area increase factor as shown in Equation 2 and Equation 3. Connection loads for the supporting structural element should be determined based on the increase in member shear capacity.

$$M_{SSE} \geq C \cdot M_{CW}$$ Equation 2

$$V_{SSE} \geq C \cdot V_{CW}$$ Equation 3

MSSE and VSSE are moment and shear capacities of supporting structural element.

MCW and VCW are moment and shear capacities of conventional wall section.

B-3.1.4.2 Reactions for Static Design.

The reactions from the supporting structural element analysis normally do not have to be carried through the horizontal and lateral bracing systems of buildings to the foundations. The main concern is that these loads are transferred into horizontal floor and roof systems without failing those connections or the attached elements, as the building mass dissipates those loads before they are transferred to the foundation. It is left to the structural engineer to assess the adequacy of these connections, the attaching elements, and the need for further analysis.

B-3.1.5 Skylights.

Because glazing fragment hazards are increased when glazing falls from the elevations of skylights, skylight glazing should be designed as a minimum to break, but remain in the frame, which is equivalent to the minimal hazard rating in ASTM F 2912 (medium level of protection in Table B-1). Use the appropriate blast load for the applicable angle of incidence to design or test the skylight.

B-3.1.6 Window and Skylight Replacement Projects.

Whenever windows and skylights are being replaced in existing buildings that have an identified explosive threat, design glazing, frames, connections, and supporting structural elements to meet all of the requirements of the following. Base the window designs on either the standoff distances to existing parking and roadways or to the planned locations for future parking and roadways in accordance with the installation or facility master plan. These provisions also apply to new windows installed in new wall openings.

Provide no less than 1/4 in. (6 mm) nominal polycarbonate or laminated glass for exterior windows or skylights. The 1/4 in. (6 mm) laminated glass consists of two nominal 1/8 in. (3 mm) glass panes bonded together with a minimum of a 0.030 in. (0.75 mm) interlayer of a material designed and tested for bomb blast resistance. For insulating glass units (IGU), use the polycarbonate or laminated glass for the innermost pane as a minimum. For laminated glass provide a glazing frame bite in accordance with ASTM F 2248. For polycarbonate provide a glazing frame bite of no less than 1.5 times the polycarbonate thickness.

B-3.1.7 Replacement with Wall or Roof Systems.

When windows or skylights are being replaced by filling in the openings with wall or roof material the openings should be filled with the same or similar construction as the adjacent wall or roof construction. Lightweight translucent fiberglass or plastic panels or other construction dissimilar to the existing adjacent construction may also be used. Regardless of the infill construction used, it must provide the applicable level of protection.

B-3.1.8 Alternative Window Treatments.

For existing buildings in which windows are not being replaced, window retrofits incorporating alternative window treatments are viable and economical solutions to mitigating the effects of explosive attacks, but will be evaluated prior to installation so that reduction in glass hazards may be validated.

B-3.1.9 Exterior Stairwells and Covered or Enclosed Walkways.

Glazing in stairwells and covered or enclosed walkways that are exterior to buildings does not need to comply with the provisions of these best practices because exterior stairwells and walkways generally are not considered to be routinely occupied. Building components behind the exterior stairwell glazing should be capable of mitigating any hazards resulting from the stairwell or enclosed walkway glazing failure in response to a blast event in accordance with the applicable levels of protection described in Table B-1. To provide that debris resistance, any windows, inner doors, sidelights, and transoms that are interior to the exterior stairwells or enclosed walkways should meet the windborne debris resistance requirements of ASTM E 1996 (missiles A and D in Table 2) All building components behind stairwells and covered or enclosed walkways should also be designed as if the stairwells or walkways were not present.

B-3.2 Exterior Doors.

For new and existing buildings for which there is an identified explosive threat provide exterior doors into inhabited areas in accordance with the provisions below

B-3.2.1 Unglazed Doors

Provide unglazed doors that are tested to achieve the applicable damage level category in Table B-1 in accordance with ASTM F 2247, with ASTM F 2927, or that meet the provisions of the Alternative Designs paragraph below.

- The fasteners and anchorage methods used to attach the tested door assembly should be representative of the actual door installation. Any deviations in actual installation of the connections or the connected elements from those tested should be demonstrated by calculation to provide the applicable level of protection for the specific application.
- The design air blast loading for the test should be the appropriate pressure and impulse from the applicable explosive weight at the actual standoff distance at which the door is sited.

B-3.2.2 Glazed Doors.

Provide glazed doors that are tested to achieve the applicable door damage level category and glazing hazard rating in Table B-1 in accordance with ASTM F 2927 or ASTM F 2247 that meet the provisions of the “Alternative Designs” paragraph below. Unless included as part of the tested assembly, glazed sidelights and transoms around doors should meet the window design requirements above.

The fasteners and anchorage methods used to attach the tested door assembly should be representative of the actual door installation. Any deviations in actual installation of the connections or the connected elements from those tested should be demonstrated by calculation to provide the applicable level of protection for the specific application. The design air blast loading for the test should be the appropriate pressure and impulse from the applicable explosive weight at the actual standoff distance between the location of the doors and potential locations for explosives.

B-3.2.3 Alternative Designs.

As an alternative to the above testing provisions for glazed and unglazed doors, position doors such that they will not be propelled into inhabited areas if they fail in response to a blast or provide other means to ensure they are intercepted by a surface with sufficient strength to keep the doors from translating into inhabited areas if they fail or otherwise ensure they do not become hazards to building occupants. The glazing in glazed doors should still meet the glazing and frame bite provisions of Standard 10 if this alternative is exercised to reduce the glazing hazard. The framing, connection, and supporting structure provisions above do not have to be applied for this alternative. Where it is not possible to design surfaces to safely intercept doors, the doors should be designed to remain in the door frames.

B-3.2.4 Vestibules or Foyers.

In vestibules, foyers, or similar entry configurations into inhabited areas where there are inner and outer doors the vestibules, foyers, or similar entries are considered not to be routinely occupied spaces. The inner doors should meet the provisions of this appendix and any other glazing associated with inner door entries such as sidelights and transoms should meet the requirements above. The inner doors and glazing should be capable of mitigating any hazards resulting from the enclosed vestibule or foyer outer doors and glazing failure in response to the design blast event. This is to account for the fact that at the levels of protection associated with these best practices the outer doors and glazing may fail, which would subject the inner doors and glazing to significant blast loads. To provide that debris resistance, the inner doors, sidelights, and transoms should meet the windborne debris resistance requirements of ASTM E 1996 (missiles A and D in Table 2).

Alternatively, exterior doors and glazed surfaces of the exteriors of vestibules or foyers can be designed to a minimum of a medium level of protection. Designing to that level will ensure that blast effects do not breach outer layers of vestibules or foyers, protecting inner doors and associated glazing from blast effects. Those inner doors and glazed surfaces could then be designed of conventional construction.

B-3.2.5 Overhead Doors.

Because it is impractical to design conventional overhead doors to meet the required performance in Table B-1, ensure overhead doors do not open into inhabited spaces or ensure that if they fail that they are intercepted by walls or tether systems that are designed with sufficient strength to keep the overhead doors from translating into areas that meet the definition of inhabited spaces.

APPENDIX C REPRESENTATIVE STANDOFF DISTANCES FOR CONVENTIONAL CONSTRUCTION AND EXPEDITIONARY STRUCTURES

C-1 INTRODUCTION.

The purpose of this appendix is to provide representative standoff distances for a number of conventionally constructed walls, roofs, and windows that fall within the parameters of Table C-5. The materials that were selected are for systems that are commonly used in DoD construction. These standoff distances should only be used for project planning and not used as a basis for final design. Even if the final structural elements fall within the parameters of Table C-5 they should be validated during design. The contents in this appendix will be included in UFC 4-020-02 when published. The information contained within may be used when a specific threat has been identified for the location or project based on UFC 4-020-01 or Service, Agency, or Geographic Combatant Command guidance.

C-2 USING THIS APPENDIX.

Each of Table C-1 through Table C-4 corresponds to specific levels of protection from very low to high. Within those columns there are standoff distances for each of the construction types in the leftmost column. Instructions for walls, roofs, and windows follow.

C-3 WALLS.

For each wall type there are two entries for each threat severity level. There is one for load bearing walls (LB) and one for non-load bearing (NLB). Either select a wall material based on available standoff distance or select a standoff distance based on a desired wall material. Note that where wall types include multiple cladding systems such as brick half way up the wall and EIFS above that, use the greater of the two applicable standoff distances for the two wall materials. Note that the walls in Table C-5 have specific ranges of spans and material properties. Table C-1 through Table C-4 are only valid within those ranges of properties. Users must not extrapolate outside of the tables.

C-4 ROOFS.

Roofs seldom control the designs of buildings with respect to blast resistance, but standoff distances for common concrete and metal roofs are tabulated for reference. Other roof types will have to be analyzed separately.

C-5 WINDOWS.

The standoff distances for windows are for conventional laminated glass windows with glazing consistent with the minimum glazing in Paragraph B-3.1.3.1. These windows can be considered conventional windows. Any standoff distances less than those in Table C-1 through Table C-4 for windows will require heavier and more costly blast resistant window systems.

C-6 EXPEDITIONARY STRUCTURES.

Standoff distances to expeditionary structures are based on structure types as indicated in Table C-6. Standoffs are based on blast testing of actual structures of the types indicated. Note that there are some entries that have NDA instead of distances. Those entries reflect instances where there was no data available to make a determination of standoff distance. Note that there are no entries for windows. If there are windows in expeditionary structures, use the window entries from Tables C-1 through C-4. For more information on standoff distances for expeditionary structures refer to the retrofit and Overpressure Design of Shelters (RODS) After Initiative Report.

Table C-1 Representative Standoff Distances for Very Low Level of Protection [7]

Construction [1]	Explosive Weight (TNT)											
	55 lbs (25 kg)		220 lbs (100 kg)		550 lbs (250 kg)		1,100 lbs (500 kg)		4,400 lbs (2,000 kg)		19,800 lbs (9,000 kg)	
	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]
Metal Stud with Lightweight Sheathing [4]	150 ft (46 m)	67 ft (20 m)	376 ft (115 m)	162 ft (49 m)	661 ft (201 m)	290 ft (88 m)	971 ft (296 m)	445 ft (136 m)	1642 ft (500 m)	988 ft (301 m)	2656 ft (809 m)	2417 ft (737 m)
Metal Stud with Brick Veneer [4]	74 ft (22 m)	31 ft (9 m)	186 ft (57 m)	84 ft (26 m)	341 ft (104 m)	152 ft (46 m)	538 ft (164 m)	235 ft (72 m)	1303 ft (397 m)	571 ft (174 m)	2545 ft (776 m)	1416 ft (431 m)
Wood Stud with Lightweight Sheathing [4]	85 ft (26 m)	55 ft (17 m)	211 ft (64 m)	139 ft (42 m)	386 ft (118 m)	253 ft (77 m)	601 ft (183 m)	395 ft (120 m)	1441 ft (439 m)	958 ft (292 m)	2645 ft (806 m)	2304 ft (702 m)
Wood Stud with Brick Veneer [4]	36 ft (11 m)	17 ft (5 m)	103 ft (31 m)	64 ft (20 m)	193 ft (59 m)	127 ft (39 m)	303 ft (92 m)	203 ft (62 m)	761 ft (232 m)	498 ft (152 m)	2010 ft (613 m)	1307 ft (398 m)
Pre-engineered Building (Girt and Metal Panel) [4]	104 ft (32 m)	39 ft (12 m)	336 ft (102 m)	108 ft (33 m)	684 ft (209 m)	213 ft (65 m)	1132 ft (345 m)	345 ft (105 m)	1668 ft (508 m)	851 ft (259 m)	2780 ft (847 m)	2418 ft (737 m)
Unreinforced Concrete Masonry [4]	80 ft (24 m)	15 ft (4 m)	262 ft (80 m)	34 ft (10 m)	535 ft (163 m)	71 ft (22 m)	906 ft (276 m)	162 ft (49 m)	1893 ft (577 m)	538 ft (164 m)	2780 ft (847 m)	1651 ft (503 m)
Unreinforced European Clay Masonry [4]	38 ft (11 m)	15 ft (5 m)	163 ft (50 m)	29 ft (9 m)	398 ft (121 m)	51 ft (16 m)	748 ft (228 m)	84 ft (26 m)	1614 ft (492 m)	302 ft (92 m)	N/A	1304 ft (398 m)
Reinforced Masonry [4]	28 ft (9 m)	13 ft (4 m)	85 ft (26 m)	20 ft (6 m)	166 ft (51 m)	38 ft (12 m)	273 ft (83 m)	78 ft (24 m)	736 ft (224 m)	221 ft (67 m)	2212 ft (674 m)	644 ft (196 m)
Reinforced Concrete [4]	22 ft (7 m)	13 ft (4 m)	104 ft (32 m)	23 ft (7 m)	234 ft (71 m)	42 ft (13 m)	424 ft (129 m)	90 ft (27 m)	1255 ft (383 m)	341 ft (104 m)	2504 ft (763 m)	1231 ft (375 m)
Concrete roofs and Metal Roofs with concrete topping [5]	13 ft (4 m)		18 ft (5 m)		25 ft (8 m)		(47 ft (14 m)		155 ft (47 m)		560 ft (171 m)	
Windows [6]	40 ft (12 m)		93 ft (28 m)		155 ft (47 m)		230 ft (70 m)		504 ft (154 m)		1070 ft (326 m)	
Minimum Standoff Distance [8]	13 ft (4 m)		20 ft (6 m)		26 ft (8 m)		33 ft (10 m)		50 ft (15 m)		82 ft (25 m)	

1. Refer to Table B-5 for details on the analysis assumptions and material properties for these wall and roof types.
2. Load bearing construction.
3. Non-load bearing construction.
4. Where wall types include multiple cladding systems such as brick half way up the wall and EIFS above that, use the greater of the two applicable standoff distances. For additional information on Steel Studs see PDC TR 15-01, Minimum Standoff Distances for Non-Load Bearing Steel Stud In-Fill Walls.
5. Roof construction seldom controls standoff distances. Standoffs of at least those in this row will commonly be adequate for those roof types. Other roof types will have to be analyzed separately
6. At distances closer than these standoff distances windows will commonly be much heavier and more expensive than conventional windows.
7. Note that these standoff distances are for planning purposes only. All building components should be designed for blast loading and conventional loading.
8. See Paragraph B-2.1.3.

Table C-2 Representative Standoff Distances for Low Level of Protection [7]

Construction [1]	Explosive Weight (TNT)											
	55 lbs (25 kg)		220 lbs (100 kg)		550 lbs (250 kg)		1,100 lbs (500 kg)		4,400 lbs (2,000 kg)		19,800 lbs (9,000 kg)	
	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]
Metal Stud with Lightweight Sheathing [4]	150 ft (46 m)	84 ft (26 m)	376 ft (115 m)	206 ft (63 m)	661 ft (201 m)	372 ft (113 m)	971 ft (296 m)	566 ft (173 m)	1642 ft (500 m)	1279 ft (390 m)	2656 ft (809 m)	2910 ft (887 m)
Metal Stud with Brick Veneer [4]	74 ft (22 m)	42 ft (13 m)	186 ft (57 m)	107 ft (33 m)	341 ft (104 m)	191 ft (58 m)	538 ft (164 m)	300 ft (91 m)	1303 ft (397 m)	730 ft (223 m)	2545 ft (776 m)	1779 ft (542 m)
Wood Stud with Lightweight Sheathing [4]	85 ft (26 m)	65 ft (20 m)	211 ft (64 m)	163 ft (50 m)	386 ft (118 m)	299 ft (91 m)	601 ft (183 m)	465 ft (142 m)	1441 ft (439 m)	1134 ft (346 m)	2645 ft (806 m)	2625 ft (800 m)
Wood Stud with Brick Veneer [4]	36 ft (11 m)	22 ft (7 m)	103 ft (31 m)	78 ft (24 m)	193 ft (59 m)	150 ft (46 m)	303 ft (92 m)	238 ft (73 m)	761 ft (232 m)	589 ft (179 m)	2010 ft (613 m)	1546 ft (471 m)
Pre-engineered Building (Girt and Metal Panel [4])	104 ft (32 m)	54 ft (17 m)	336 ft (102 m)	151 ft (46 m)	684 ft (209 m)	287 ft (88 m)	1132 ft (345 m)	458 ft (140 m)	1668 ft (508 m)	1294 ft (394 m)	2780 ft (847 m)	2985 ft (910 m)
Unreinforced Concrete Masonry [4]	80 ft (24 m)	26 ft (8 m)	262 ft (80 m)	124 ft (38 m)	535 ft (163 m)	276 ft (84 m)	906 ft (276 m)	484 ft (148 m)	1893 ft (577 m)	1393 ft (425 m)	2780 ft (847 m)	2940 ft (896 m)
Unreinforced European Clay Masonry [4]	38 ft (11 m)	22 ft (7 m)	163 ft (50 m)	59 ft (18 m)	398 ft (121 m)	148 ft (45 m)	748 ft (228 m)	314 ft (96 m)	1614 ft (492 m)	1146 ft (349 m)	N/A	2688 ft (819 m)
Reinforced Masonry [4]	28 ft (9 m)	13 ft (4 m)	85 ft (26 m)	30 ft (9 m)	166 ft (51 m)	72 ft (22 m)	273 ft (83 m)	120 ft (37 m)	736 ft (224 m)	326 ft (99 m)	2212 ft (674 m)	945 ft (288 m)
Reinforced Concrete [4]	22 ft (7 m)	14 ft (4 m)	104 ft (32 m)	35 ft (11 m)	234 ft (71 m)	105 ft (32 m)	424 ft (129 m)	200 ft (61 m)	1255 ft (383 m)	663 ft (202 m)	2504 ft (763 m)	2122 ft (647 m)
Concrete roofs and Metal Roofs w/ concrete topping[5]	13 ft (4 m)		23 ft (7 m)		50 ft (15 m)		92 ft (28 m)		270 ft (82 m)		737 ft (225 m)	
Windows [6]	51 ft (15 m)		123 ft (37 m)		197 ft (60 m)		269 ft (82 m)		545 ft (166 m)		1092 ft (333 m)	
Minimum Standoff Distance [8]	13 ft (4 m)		20 ft (6 m)		26 ft (8 m)		33 ft (10 m)		50 ft (15 m)		82 ft (25 m)	

1. Refer to Table B-5 for details on the analysis assumptions and material properties for these wall and roof types.
2. Load bearing construction.
3. Non-load bearing construction.
4. Where wall types include multiple cladding systems such as brick half way up the wall and EIFS above that, use the greater of the two applicable standoff distances. For additional information on Steel Studs see PDC TR 15-01, Minimum Standoff Distances for Non-Load Bearing Steel Stud In-Fill Walls.
5. Roof construction seldom controls standoff distances. Standoffs of at least those in this row will commonly be adequate for those roof types. Other roof types will have to be analyzed separately
6. At distances closer than these standoff distances windows will commonly be much heavier and more expensive than conventional windows.
7. Note that these standoff distances are for planning purposes only. All building components should be designed for blast loading and conventional loading.
8. See Paragraph B-2.1.3.

Table C-3 Representative Standoff Distances for Medium Level of Protection [7]

Construction [1]	Explosive Weights (TNT)											
	55 lbs (25 kg)		220 lbs (100 kg)		550 lbs (250 kg)		1,100 lbs (500 kg)		4,400 lbs (2,000 kg)		19,800 lbs (9,000 kg)	
	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]
Metal Stud with Lightweight Sheathing [4]	311 ft (95 m)	150 ft (46 m)	701 ft (214 m)	376 ft (115 m)	844 ft (257 m)	661 ft (201 m)	1004 ft (306 m)	971 ft (296 m)	1504 ft (459 m)	1642 ft (500 m)	2567 ft (783 m)	2656 ft (809 m)
Metal Stud with Brick Veneer [4]	148 ft (45 m)	74 ft (22 m)	380 ft (116 m)	186 ft (57 m)	710 ft (216 m)	341 ft (104 m)	1145 ft (349 m)	538 ft (164 m)	1679 ft (512 m)	1303 ft (397 m)	2745 ft (837 m)	2545 ft (776 m)
Wood Stud with Lightweight Sheathing [4]	151 ft (46 m)	85 ft (26 m)	390 ft (119 m)	211 ft (64 m)	714 ft (218 m)	386 ft (118 m)	1076 ft (328 m)	601 ft (183 m)	1553 ft (473 m)	1441 ft (439 m)	2726 ft (831 m)	2645 ft (806 m)
Wood Stud with Brick Veneer [4]	67 ft (21 m)	36 ft (11 m)	186 ft (57 m)	103 ft (31 m)	345 ft (105 m)	193 ft (59 m)	554 ft (169 m)	303 ft (92 m)	1402 ft (427 m)	761 ft (232 m)	2642 ft (805 m)	2010 ft (613 m)
Pre-engineered Building (Girt and Metal Panel [4])	269 ft (82 m)	104 ft (32 m)	633 ft (193 m)	336 ft (102 m)	818 ft (249 m)	684 ft (209 m)	1096 ft (334 m)	1132 ft (345 m)	1682 ft (513 m)	1668 ft (508 m)	2505 ft (764 m)	2780 ft (847 m)
Unreinforced Concrete Masonry [4]	365 ft (111 m)	80 ft (24 m)	567 ft (173 m)	262 ft (80 m)	808 ft (246 m)	535 ft (163 m)	1033 ft (315 m)	906 ft (276 m)	1512 ft (461 m)	1893 ft (577 m)	2515 ft (767 m)	2780 ft (847 m)
Unreinforced European Clay Masonry [4]	N/A	38 ft (11 m)	N/A	163 ft (50 m)	N/A	398 ft (121 m)	N/A	748 ft (228 m)	N/A	1614 ft (492 m)	N/A	N/A
Reinforced Masonry [4]	224 ft (68 m)	28 ft (9 m)	563 ft (171 m)	85 ft (26 m)	768 ft (234 m)	166 ft (51 m)	1010 ft (308 m)	273 ft (83 m)	1598 ft (487 m)	736 ft (224 m)	2691 ft (820 m)	2212 ft (674 m)
Reinforced Concrete [4]	276 ft (84 m)	22 ft (7 m)	489 ft (149 m)	104 ft (32 m)	822 ft (251 m)	234 ft (71 m)	918 ft (280 m)	424 ft (129 m)	1433 ft (437 m)	1255 ft (383 m)	2672 ft (814 m)	2504 ft (763 m)
Concrete roofs and Metal Roofs w/ concrete topping[5]	15 ft (5 m)		43 ft (15 m)		101 ft (31 m)		171 ft (52 m)		443 ft (166 m)		1086 ft (333 m)	
Windows [6]	51 ft (15 m)		123 ft (37 m)		197 ft (60 m)		269 ft (82 m)		545 ft (166 m)		1092 ft (333 m)	
Minimum Standoff Distance [8]	13 ft (4 m)		20 ft (6 m)		26 ft (8 m)		33 ft (10 m)		50 ft (15 m)		82 ft (25 m)	

1. Refer to Table B-5 for details on the analysis assumptions and material properties for these wall and roof types.
2. Load bearing construction.
3. Non-load bearing construction.
4. Where wall types include multiple cladding systems such as brick half way up the wall and EIFS above that, use the greater of the two applicable standoff distances. For additional information on Steel Studs see PDC TR 15-01, Minimum Standoff Distances for Non-Load Bearing Steel Stud In-Fill Walls.
5. Roof construction seldom controls standoff distances. Standoffs of at least those in this row will commonly be adequate for those roof types. Other roof types will have to be analyzed separately
6. At distances closer than these standoff distances windows will commonly be much heavier and more expensive than conventional windows.
7. Note that these standoff distances are for planning purposes only. All building components should be designed for blast loading and conventional loading.
8. See Paragraph B-2.1.3.

Table C-4 Representative Standoff Distances for High Level of Protection [7]

Construction [1]	Explosive Weights (TNT)											
	55 lbs (25 kg)		220 lbs (100 kg)		550 lbs (250 kg)		1,100 lbs (500 kg)		4,400 lbs (2,000 kg)		19,800 lbs (9,000 kg)	
	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]	LB [2]	NLB [3]
Metal Stud with Lightweight Sheathing [4]	311 ft (95 m)	311 ft (95 m)	701 ft (214 m)	701 ft (214 m)	844 ft (257 m)	844 ft (257 m)	1004 ft (306 m)	1004 ft (306 m)	1504 ft (459 m)	1504 ft (459 m)	2567 ft (783 m)	2567 ft (783 m)
Metal Stud with Brick Veneer [4]	148 ft (45 m)	148 ft (45 m)	380 ft (116 m)	380 ft (116 m)	710 ft (216 m)	710 ft (216 m)	1145 ft (349 m)	1145 ft (349 m)	1679 ft (512 m)	1679 ft (512 m)	2745 ft (837 m)	2745 ft (837 m)
Wood Stud with Lightweight Sheathing [4]	151 ft (46 m)	151 ft (46 m)	390 ft (119 m)	390 ft (119 m)	714 ft (218 m)	714 ft (218 m)	1076 ft (328 m)	1076 ft (328 m)	1553 ft (473 m)	1553 ft (473 m)	2726 ft (831 m)	2726 ft (831 m)
Wood Stud with Brick Veneer [4]	67 ft (21 m)	67 ft (21 m)	186 ft (57 m)	186 ft (57 m)	345 ft (105 m)	345 ft (105 m)	554 ft (169 m)	554 ft (169 m)	1402 ft (427 m)	1402 ft (427 m)	2642 ft (805 m)	2642 ft (805 m)
Pre-engineered Building (Girt and Metal Panel) [4]	269 ft (82 m)	269 ft (82 m)	633 ft (193 m)	633 ft (193 m)	818 ft (249 m)	818 ft (249 m)	1096 ft (334 m)	1096 ft (334 m)	1682 ft (513 m)	1682 ft (513 m)	2505 ft (764 m)	2505 ft (764 m)
Unreinforced Concrete Masonry	365 ft (111 m)	365 ft (111 m)	567 ft (173 m)	567 ft (173 m)	808 ft (246 m)	808 ft (246 m)	1033 ft (315 m)	1033 ft (315 m)	1512 ft (461 m)	1512 ft (461 m)	2515 ft (767 m)	2515 ft (767 m)
Unreinforced European Clay Masonry [4]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reinforced Masonry [4]	224 ft (68 m)	224 ft (68 m)	563 ft (171 m)	563 ft (171 m)	768 ft (234 m)	768 ft (234 m)	1010 ft (308 m)	1010 ft (308 m)	1598 ft (487 m)	1598 ft (487 m)	2691 ft (820 m)	2691 ft (820 m)
Reinforced Concrete [4]	276 ft (84 m)	276 ft (84 m)	489 ft (149 m)	489 ft (149 m)	822 ft (251 m)	822 ft (251 m)	918 ft (280 m)	918 ft (280 m)	1433 ft (437 m)	1433 ft (437 m)	2672 ft (814 m)	2672 ft (814 m)
Concrete roofs and Metal Roofs w/ concrete topping [5]	208 ft (63 m)		381 ft (116 m)		542 ft (184 m)		699 ft (213 m)		1137 ft (347 m)		2135 ft (651 m)	
Windows [6]	189 ft (58 m)		392 ft (119 m)		602 ft (184 m)		805 ft (245 m)		1412 ft (430 m)		2147 ft (654 m)	
Minimum Standoff Distance [8]	13 ft (4 m)		20 ft (6 m)		26 ft (8 m)		33 ft (10 m)		50 ft (15 m)		82 ft (25 m)	

1. Refer to Table B-5 for details on the analysis assumptions and material properties for these wall and roof types.
2. Load bearing construction.
3. Non-load bearing construction.
4. Where wall types include multiple cladding systems such as brick half way up the wall and EIFS above that, use the greater of the two applicable standoff distances. For additional information on Steel Studs see PDC TR 15-01, Minimum Standoff Distances for Non-Load Bearing Steel Stud In-Fill Walls.
5. Roof construction seldom controls standoff distances. Standoffs of at least those in this row will commonly be adequate for those roof types. Other roof types will have to be analyzed separately
6. At distances closer than these standoff distances windows will commonly be much heavier and more expensive than conventional windows.
7. Note that these standoff distances are for planning purposes only. All building components should be designed for blast loading and conventional loading.
8. See Paragraph B-2.1.3.

Table C-5 Conventional Construction Parameters

Wall or Roof Type[1]	Analysis Assumptions[2, 10]						
	Sections	Span	Spacing	Support Condition	Supported Weight[5]	Reinforcement Ratio	Min. Static Material Strength
Wood Studs – Brick Veneer	2x4 & 2x6 in (50x100 & 50x150 mm)	8 – 10 ft (2.4 - 3 m)	16 - 24 in (400 – 600 mm)	S-S	44 psf (215 kg/m^2)	N/A	875 psi (6 MPa)
Wood Studs – EIFS	2x4 & 2x6 in (50x100 & 50x150 mm)	8 – 10 ft (2.4 – 3 m)	16 -24 in (400 -600 mm)	S-S	10 psf (49 kg/m^2)	N/A	875 psi (6 MPa)
Steel Studs – Brick Veneer[3]	600S162-43 600S162-54 600S162-68	8 – 12 ft (2.4 – 3.7 m)	16 - 24 in (400 – 600 mm)	S-S	44 psf (215 kg/m^2)	N/A	50,000 psi (345 MPa)
Steel Studs – EIFS[3]	600S162-43 600S162-54 600S162-68	8 – 12 ft (2.4 – 3.7 m)	16 - 24 in (400 – 600 mm)	S-S	10 psf (49 kg/m^2)	N/A	50,000 psi (345 MPa)
Metal Panels[6] (in wall or roof construction)	1.5 – 3 in (38 - 76 mm) 22, 20, & 18 ga	4 – 8 ft (1.2 - 2.4 m)	N/A	S-S	10 psf (49 kg/m^2)	N/A	33,000 psi (228 MPa)
Girts[6] (in wall or roof construction)	8Z3 &10Z3 16, 14, & 12 ga	20 – 25 ft (6 – 7.6 m)	6 – 8 ft (1.8 – 2.4 m)	S-S	5 psf (24 kg/m^2)	N/A	50,000 psi (345 MPa)
Reinforced Concrete[7]	≥ 6 in (≥ 150 mm)	12 – 20 ft (3.7- 6 m)	N/A	S-S, One way flexure	10 psf (49 kg/m^2)	≥ 0.0015	3,000 psi (21 MPa)
Unreinforced Concrete Masonry [4, 8]	6 – 12 in (150 – 300 mm)	8 – 12 ft (2.4 – 3.7 m)	N/A	S-S, One way flexure	10 psf (49 kg/m^2)	0	1,500 psi (10 MPa)
Reinforced Concrete Masonry [7, 8]	8 – 12 in (200 - 300 mm)	10 – 14 ft (3 – 4.3 m)	N/A	S-S, One way flexure	10 psf (49 kg/m^2)	0.0005 - 0.0030	1,500 psi (10 MPa)

Wall or Roof Type[1]	Analysis Assumptions[2, 10]						
	Sections	**Span**	**Spacing**	**Support Condition**	**Supported Weight[5]**	**Reinforcement Ratio**	**Min. Static Material Strength**
European Clay Block Masonry[4, 9]	6 – 8 in (150 – 200 mm)	10 – 12 ft (3 – 3.7 m)	N/A	S-S, Brittle Flexure	10 psf (49 kg/m^2)	0	1,800 psi (12 MPa)
Concrete Roofs[7]	4 – 12 in (100 - 300 mm)	6 ft (1.8 m)	N/A	F-S	15 psf (73 kg/m^2)	0.0015 - 0.005	3,000 psi (21 Mpa)
Metal Roofs	K and LH joists with Metal Deck and/or 3.5 - 5.5 in (90 - 140 mm) Concrete Topping	30 ft (9.1m)	4 – 8 ft (1.2 – 2.4 m)	S-S	15 – 90 psf (73 – 439 kg/m^2)	N/A	50,000 psi (345 MPa)

1. Other types of construction other than that shown in this table may be permissible subject to validation by the designer of record.
2. See PDC Technical Report 10-01 for details on the analysis assumptions and material properties.
3. Steel studs are assumed to be connected top and bottom for load bearing walls. For non-load bearing walls steel studs are assumed to have a slip-track connection at the top. For additional information on Steel Studs see PDC TR 15-01, Minimum Standoff Distances for Non-Load Bearing Steel Stud In-Fill Walls.
4. Unreinforced masonry must have adequate lateral support at the top and bottom.
5. Weight supported by the wall that moves through the same deflection as the wall, not including self-weight of the component.
6. For walls or roofs built using metal panels and girts; use the greater of the standoffs for the metal panel and the girt.
7. Reinforcing steel is 60,000 psi (414 MPa) tensile strength.
8. Concrete Masonry Units (excluding European block) are medium weight (120 pcf / 1922 kg/m^3)
9. European clay block masonry complies with DIN: 105 Teil 1 + 2/HLz B
10. Shear will need to be checked when using higher than minimum material strengths.

S-S = Simple - Simple Supports F-S = Fixed - Simple Supports

Table C-6 Standoff Distances for Expeditionary Structures

Explosive Weight	LOP	Expeditionary Structure Type			
		TEMPER and GP Tents	Small Shelter System	SEA Hut	Retrofitted SEA Hut
55 lbs (25 kg)	VL	33 ft (10 m)	33 ft (10 m)	75 ft (23 m)	NDA*
	L	46 ft (14 m)	46 ft (14 m)	105 ft (32 m)	45 ft (14m)
	M	67 ft (20 m)	59 ft (18 m)	135 ft (41 m)	65 ft (20 m)
	H	157 ft (48 m)	NDA	190 ft (58 m)	90 ft (27 m)
220 lbs (25 kg)	VL	79 ft (24 m)	79 ft (24 m)	154 ft (47 m)	NDA
	L	115 ft (35 m)	105 ft (32 m)	177 ft (54 m)	94 ft (29 m)
	M	145 ft (44 m)	145 ft (44 m)	256 ft (78 m)	123 ft (38 m)
	H	355 ft (108 m)	NDA	375 ft (114 m)	184 ft (56 m)
550 lbs (250 kg)	VL	NDA	NDA	NDA	NDA
	L	176 ft (54 m)	180 ft (55 m)	269 ft (82 m)	133 ft (41 m)
	M	220 ft (67 m)	249 ft (76 m)	387 ft (117 m)	178 ft (54 m)
	H	540 ft (165 m)	NDA	558 ft (170 m)	275 ft (84 m)
1100 lbs (550 kg)	VL	NDA	NDA	NDA	NDA
	L	243 ft (74 m)	262 ft (80 m)	355 ft (108 m)	174 ft (53 m)
	M	299 ft (91 m)	355 ft (108 m)	515 ft (157 m)	237 ft (72 m)
	H	705 ft (215 m)	NDA	760 ft (232 m)	355 ft (108 m)
4400 lbs (2000 kg)	VL	NDA	NDA	NDA	NDA
	L	447 ft (145 m)	490 ft (149 m)	576 ft (176 m)	288 ft (88 m)
	M	507 ft (155 m)	640 ft (195 m)	820 ft (250 m)	395 ft (120 m)
	H	1216 ft (371 m)	NDA	1285 ft (392 m)	593 ft (181 m)
19,800 lbs	VL	NDA	NDA	NDA	NDA
	L	755 ft (230 m)	924 ft (282 m)	NDA	NDA
	M	870 ft (265 m)	1285 ft (392 m)	1370 ft (418 m)	646 ft (197 m)
	H	2089 ft (637 m)	NDA	NDA	NDA
* NDA stands for No Data Available					

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APPENDIX D GLOSSARY

D-1 ABBREVIATIONS AND ACRONYMS.

ACHP Advisory Council on Historic Preservation

ANSI American National Standards Institute

ARPA Archaeological Resources Protection Act

ASTM Not an Abbreviation (Formerly American Society of Testing and Materials, now ASTM International)

AT Antiterrorism

BIA Bilateral Infrastructure Agreements

BOMA Building Owners and Managers Association

C Tributary width increase factor

CCSD Conventional Construction Standoff Distance

CFM Cubic Feet per Minute

cm Centimeter

CONEX Container Express

DIN Deutsches Institut fur Normung (German Institute for Standardization)

DBT Design Basis Threat

DoD Department of Defense

EIFS Exterior Insulation and Finish System

ESC Expandable Shelter Containers

FCU Fan Coil Unit

FPCON Force Protection Condition

FSTFS Frame-Supported Tensioned Fabric Structures

ft. Feet

GCC Geographic Combatant Commander

GP General Purpose

GSA	General Services Administration (U.S.)
HNFA	Host Nation Funded Construction Agreement
HOA	Hand/Off/Auto
HQUSACE	Headquarters, US Army Corps of Engineers
HVAC	Heating, Ventilating, and Air Conditioning
IGU	Insulating Glass Units
in.	Inches
ISC	Interagency Security Committee
JFOB	Joint Forward Operations Base
Kg/m^2	Kilograms per square meter
Kg/m^3	Kilograms per cubic meter
LB	Load Bearing
LOC	Local Operating Console
m	Meters
MILCON	Military Construction
mm	Millimeters
MNS	Mass Notification Systems
MPa	MegaPascals
MSS	Medium Shelter Systems
M_{CW}	Moment, conventional wall
M_{SSE}	Moment, Supporting Structural Element
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command
NCR	National Capital Region
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act

NLB Non-Load Bearing

OPORD Operations Orders

OSD Office of the Secretary of Defense

Pa Pascals

PCF Pounds per cubic foot

PDC Protective Design Center

PSF Pounds per square foot

PSI Pounds per square inch

RFP Request for Proposal

R_M Minimum Standoff Distance

SHAPE Supreme Headquarters Allied Powers Europe

SOFA Status of Forces Agreement

SSS Small Shelter System

TEMPER Tent, Extendable, Modular, Personnel

TNT Trinitrotoluene

UFC Unified Facilities Criteria

USD (AT&L) Undersecretary of Defense for Acquisition, Technology, and Logistics

V_{CW} Shear, conventional wall

V_{SSE} Shear, Supporting Structural Element

D-2 DEFINITIONS OF TERMS.

Access control. For the purposes of these standards, any combination of barriers, gates, electronic security equipment, and/or guards that can limit entry or parking of unauthorized personnel or vehicles.

Access road. Any roadway such as a maintenance, delivery, service, emergency, or other special limited use road that is necessary for the operation of a building or structure.

Analysis. For the purposes of evaluating compliance with standoff distance and supporting structure requirements of these standards, evaluation of structural components using commonly accepted analysis methodologies such as single degree of freedom or finite element analysis.

Breezeway. A covered passage that passes between two buildings or portions of buildings or covered areas underneath or attached to buildings.

Building. A structure, usually enclosed by walls and a roof, constructed to provide support or shelter for an intended occupancy. Note that other structures, such as canopies or gazebos, are not considered buildings for the purposes of these standards.

Building hardening. Enhanced conventional construction that mitigates threat hazards where standoff distance is limited. Building hardening may also be considered to include the prohibition of certain building materials and construction techniques.

Building occupancy. For the purposes of these standards, the planned occupancy of a building or the allowable occupancy calculated in accordance with life safety codes where the occupancy is not known.

Building overhangs. Any structural configuration in which the outer walls or columns of the ground floor are set back from the outer walls or column lines of floors above.

Building separation. The distance between closest points on the exterior walls of adjacent buildings or structures.

Clear Zone. Areas commonly associated with perimeters that are free of all obstacles, topographical features, and vegetation exceeding 8 in. (152 mm) in height that could impede observation or provide cover and concealment of an aggressor.

Collateral damage. Injury to personnel or damage to buildings that are not the primary targets of attacks.

Command vehicles. Government owned or leased vehicles operated by installation or senior mission commanders, exclusive of privately owned vehicles

Commercial facilities. Facilities that are not DoD owned or operated and that support commercial activities other than food service and retail activities such as banks.

Container structures. Structures built using shipping containers that are designed to withstand structural loadings associated with shipping, including Container Express (CONEX) and International Organization for Standardization (ISO) containers. Testing has shown that these structures behave similarly to buildings for the purposes of these standards.

Controlled parking. For the purposes of these standards, parking that is limited to authorized vehicles that is enforced through physical security measures such as card operated gates, identification or vehicle checks by personnel or similar measures that are acceptable to physical security personnel.

Controlled perimeter. For the purposes of these standards, a physical boundary at which vehicle access is controlled with sufficient means to channel vehicles to the access control points. At a minimum, access control at a controlled perimeter requires the demonstrated capability to search for and detect explosives. Where the controlled perimeter includes a shoreline and there is no defined perimeter beyond the shoreline, the boundary for measuring standoff distances will be at the mean high water mark or the elevation associated with top of bank (associated with a flood recurrence interval of 1.2 years).

Conventional construction. Building construction that is not specifically designed to resist weapons or explosives effects. Conventional construction is designed only to resist common loadings and environmental effects such as wind, seismic, and snow loads. Note that for the purposes of these standards, conventional construction may still require special windows, structural reinforcement around windows, and progressive collapse resistant construction.

Conventional construction standoff distance. The standoff distances at which conventional construction may be used for building components other than doors and windows without a specific analysis of blast effects, except as otherwise required in these standards.

Change of occupancy. Change of occupancy level as defined in these standards. It does not relate to conversions of facility category code. Examples include occupancy changing from low occupancy to inhabited.

Design basis threat. The threat (aggressors, tactics, and associated weapons, tools or explosives) against which assets within a building must be protected and upon which the security engineering design of the building is based.

DoD building. Any building or portion of a building (permanent, temporary, or expeditionary) owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD. DoD buildings other than leased buildings are categorized within these standards as low occupancy, inhabited, and high occupancy family housing.

DoD components. The Office of the Secretary of Defense (OSD); the Military Departments (including their National Guard and Reserve Components); the Chairman, Joint Chiefs of Staff and Joint Staff; the Combatant Commands; the Office of the

Inspector General of the Department of Defense; the Defense Agencies; the DoD Field Activities; and all other organizational entities within DoD.

DoD Installation. A base, camp, post, yard, center, homeport facility for any ship, or other activity under the jurisdiction of the Department of Defense

DoD personnel. Any U.S. military, DoD civilian or family member thereof, host-nation employees working for DoD, or contractors occupying DoD buildings. For the purposes of these standards, non-DoD visitors to DoD owned or controlled visitor centers, visitor control centers, museums, and similar facilities will be included in DoD personnel populations of those facilities. Visitor counts will be based on routine visitor levels.

Door. A building component for opening or closing an opening in a wall that allows normal access and passage.

Emergency vehicles. Vehicles such as fire trucks and ambulances and other vehicles that are critical to emergency response and for which close proximity to inhabited buildings or containment therein is essential.

Enhanced use lease. Out leases of non-excess DoD land or facilities to a public or private entities for development under the authority of 10 US Code Section 2667.

Equivalent level of protection. Performance of building components that results in building damage or door and glazing hazards similar to that required for the required level of protection as described in Table B-1 or as specified in PDC Technical Report 06-08.

Expeditionary structures. Structures that are erected in forward operating locations and that are intended to be occupied only during the period of operations. This group of structures typically includes but is not limited to tents, Small and Medium Shelter Systems, Expandable Shelter Containers (ESC), ISO and CONEX containers, General Purpose (GP) Medium tents and GP Large tents, trailers, and modular and light wood framed structures.

Fabric covered structures. A construction type that can be identified by wood or metal (usually aluminum) posts or load-bearing frames with some type of fabric (such as canvas) stretched or pulled over the posts or frames. Examples of the types of structures that should be considered under this classification of structures include Frame-Supported Tensioned Fabric Structures (FSTFS); Tent, Extendable, Modular, Personnel (TEMPER Tents); and Small and Medium Shelter Systems (SSS and MSS); General Purpose (GP) Medium tents and GP Large tents; and air supported fabric structures. Testing has shown that for these fabric structures, the posts and frames are what cause hazards.

Family housing. DoD buildings used as quarters for DoD personnel and their dependents. For the purposes of these standards, family housing will be considered to include Morale, Welfare, and Recreation housing (cottages) and temporary family lodging of similar occupancies.

Fan Coil Unit (FCU). A device consisting of a heating and / or cooling heat exchanger (coil) and a fan.

Final denial active vehicle barrier. Vehicle barriers that can be raised and lowered or otherwise moved to block traffic lanes to stop the motion of threat vehicles. In Entry Control Facilities / Access Control Points they are located at the end of the response zone (see UFC 4-022-01).

Fisher Houses. Houses constructed by the Fisher House Foundation at military medical centers for lodging families of military personnel while the military personnel are hospitalized.

Force Protection Condition (FPCON). A DoD-approved system that standardizes the Departments' identification and recommended preventive actions and responses to terrorist threats against U.S. personnel and facilities. This system is the principle means for a commander to apply an operational decision on how to protect against terrorism and facilitates inter-Service coordination and support for antiterrorism activities.

Glazing. The part of a window, skylight, or door assembly that is transparent or translucent and transmits light, but not air.

High occupancy family housing. Family housing with 13 or more units per building.

Identification check point. The location in an Entry Control Facility / Access Control Point at which driver identification is checked to control access into controlled perimeters

Inhabited building. Buildings or portions of buildings routinely occupied by 11 or more DoD personnel and with a population density of greater than one person per 430 gross square feet (40 gross square meters). This density generally excludes industrial, maintenance, and storage facilities, except for more densely populated portions of those buildings such as administrative areas. The inhabited building designation also applies to expeditionary structures with similar population densities. In a building that meets the criterion of having 11 or more personnel with low occupancy portions that do not have sufficient population densities to qualify as inhabited buildings, those portions that have sufficient population densities will be considered inhabited buildings while the remainder of the building may be considered low occupancy, subject to provisions of these standards. An example would be a hangar, warehouse, or maintenance facility with an administrative area within it. The administrative area would be treated as an inhabited building while the remainder of the facility could be treated as low occupancy. External stairwells and covered or enclosed walkways are not part of the inhabited space of a building. (Note: This definition differs significantly from the definition for inhabited building used by DoD 6055.09-M and is not to be construed as authorization to deviate from criteria of DoD 6055.09-M.)

Installation: For the purposes of these standards, the installation is an area or locality subject to the custody, jurisdiction, or administration of the Secretary of a Military

Department or the Secretary of Defense, in the case of an activity in a foreign country, under the operational control of the Secretary of a Military Department or the Secretary of Defense. This term includes but not limited to, military reservations, bases, posts, camps, stations, or arsenals.

Installation Perimeter: For the purposes of these standards, the installation perimeter is defined as any demarcation identifying the limit of DoD property and directly or indirectly indicating that unauthorized access is prohibited. The landside perimeter may be established with fences, walls, signage, natural barriers or other means. The waterside perimeter will be at the mean high water mark or the elevation associated with top of bank (associated with a flood) recurrence interval of 1.2 years) or be established with channel markers, buoys, float lines, signage, or boat barriers.

Laminated glass. Multiple sheets of glass bonded together by a bonding interlayer.

Level of protection. The degree to which an asset (person, equipment, object, etc.) is protected against injury or damage from an attack.

Low occupancy building. Any building or portion of a building routinely occupied by fewer than 11 DoD personnel or with a population density of less than one person per 430 gross square feet (40 gross square meters).

Low occupancy family housing. Family housing with 12 or fewer units per building.

Mail room. A facility operated by or for the Department of Defense for the receipt and delivery of mail for military units or other authorized organizations and agencies by entities outside the DoD. This does not include mail rooms that receive mail distribution that was initially received at a central DoD mail handling facility.

Mass notification. Capability to provide real-time information to all building occupants or personnel in the immediate vicinity of a building during emergency situations.

Military protective construction. Military facilities designed to resist military conventional and nuclear weapons to the NATO (or equivalent) standards of hardened, protected, semi-hardened, collaterally protected, or splinter protected.

Minimum standoff distance. The smallest permissible standoff distance regardless of any analysis results or hardening of the building.

Mobile ground tactical platforms. Vehicle mounted tactical ground station for posting, processing, and distributing real-time intelligence, surveillance, and reconnaissance information.

Operations support vehicles. Vehicles such as airfield support equipment or material handling equipment whose purpose is direct support to operations and which are operated only within a restricted access area.

Parking areas. Designated areas where vehicles may be left unattended, including parking lots, designated parking areas along roadways, and roadways within or accessing parking areas.

Progressive collapse. The spread of an initial local failure from building element to building element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it.

Punched window. A window installed as a punched opening surrounded by cladding, as opposed to being arranged in vertical or horizontal strips.

Relocatable building. Personal property used as a structure designed to be readily moved, erected, disassembled, stored, and reused and whose sum of building disassembly, repackaging, and non-recoverable building components, including typical foundation costs does not exceed 20% of the purchase cost of the relocatable building. Personal property is managed as equipment as opposed to real property.

Replacement Cost. The cost to design and construct a facility to current standards and building codes to replace an existing facility at the same location calculated in accordance with UFC 3-701-01.

Ribbon window. Windows installed in vertical or horizontal strips with no building wall elements between them but surrounded by cladding around the overall opening perimeter.

Roadways. Any surface intended for routine motorized vehicle traffic, including driving lanes of parking areas.

Routinely occupied. For the purposes of these standards, an established or predictable pattern of activity within a building that terrorists could recognize and exploit.

Scaled Range. A relationship based on cube-root scaling that allows comparisons to be made among blast wave properties created by detonations of different explosive quantities.

Security engineering. The process of identifying practical, risk managed short and long-term solutions to reduce and/or mitigate dynamic manmade hazards by integrating multiple factors, including construction, equipment, manpower, and procedures.

Skylight. Sloped or horizontal application of a fenestration product that allows for natural day lighting and that may be either fixed (non-operable) or venting (operable).

Spandrel Glass. Glass used in non-vision areas of building exteriors

Specific threat. Known or postulated aggressor activity focused on targeting a particular asset.

Standoff distance. A distance maintained between a building or portion thereof and the potential location for an explosive detonation.

Structural glazed window systems. Window systems in which glazing is bonded to both sides of the window frame using an adhesive such as a high-strength, high-performance structural silicone.

Superstructure. The supporting elements of a building above the foundation.

Supporting structural elements. Structural elements that support windows and that are not in direct contact with the glass, such as walls.

Temporary buildings. For the purposes of these standards, those buildings, other than expeditionary structures, that are real property facilities and are designed and constructed with a life expectancy of five years or less.

Testing. For the purposes of these standards, experiments performed in accordance with standardized procedures that prove that building components meet the performance required to meet a specific level of protection.

Town Centers. Mixed use small scale retail, health, or community services and family housing facilities in the same buildings.

TNT equivalent weight. The weight of TNT (trinitrotoluene) that has an equivalent energetic output to that of a different weight of another explosive compound.

Transitional structures and spaces. Structures or spaces within buildings that are used to temporarily relocate DoD occupants of buildings while those buildings or other buildings to which they will relocate undergo renovations, modifications, repairs, or restorations or are being constructed. (Also known as swing space.)

Uncontrolled Public Access. Spaces within and beneath buildings where there is insufficient positive access control to preclude unauthorized access. For the purposes of these standards, positive access control will be considered to include (but not be limited to) electronic access control on all exterior doors or providing personnel to control visitors.

Unobstructed space. Space around inhabited buildings in which there are no opportunities for concealment from observation of explosive devices of no less than a 6 in. (150 mm) cube.

Window or Skylight Replacement. The removal of an existing window or skylight assembly and replacement with a new window assembly. For the purposes of this definition a "window assembly" is considered to be the entire system of glazing, framing and anchorage components that fill in and fit within the opening in the wall or roof structure.

APPENDIX E REFERENCES

ADVISORY COUNCIL ON HISTORIC PRESERVATION

http://www.achp.gov/

36 CFR Part 800, *Protection of Historic Properties*

ASTM INTERNATIONAL

http://www.astm.org

ASTM E1300, *Standard Practice for Determining Load Resistance of Glass in Buildings*

ASTM E1996, *Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes*

ASTM F1642, *Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings*

ASTM F2247, *Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Method)*

ASTM F2248, *Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass*

ASTM F2912, *Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings*

ASTM F2927, *Standard Test Method for Door Systems Subject to Airblast Loadings*

DEPARTMENT OF DEFENSE

http://www.dtic.mil/whs/directives/index.html

DoD 6055.09-M, *DoD Ammunition and Explosive Safety Standards*

DoD Instruction 2000.12, *DoD Antiterrorism (AT) Program*

DoD Instruction O-2000.16, *DoD Antiterrorism (AT) Program Implementation (Volumes 1 and 2)*

GTA 90-01-011, *Joint Forward Operations Base (JFOB) Survivability and Protective Construction Handbook (For Official Use Only [FOUO])*

The Deputy Secretary of Defense, 7 December 2012, *Memorandum, Subject: Antiterrorism Building Standards for Leased Space*

DEPARTMENT OF DEFENSE, UNIFIED FACILITIES CRITERIA PROGRAM

http://dod.wbdg.org/

Military Standard (MIL-STD) 3007, *Department Of Defense Standard Practice Standard Practice For Unified Facilities Criteria and Unified Facilities Guide Specifications*

UFC 1-200-01, *DoD Building Code (General Building Requirements)*

UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual*

UFC 4-020-02FA, *DoD Security Engineering Facilities Design Manual*

UFC 4-021-01, *Design and O&M: Mass Notification Systems*

UFC 4-022-01, *Security Engineering: Entry Control Facilities/Access Control Points*

UFC 4-023-03, *Design of Buildings to Resist Progressive Collapse*

UFC 4-023-07, *Design to Resist Direct Fire Weapons Effects*

UFC 3-701-01, *DoD Facilities Pricing Guide for FY2011, March 2011, with Change 1*

UFC 3-301-01, *Structural Engineering*

DEPARTMENT OF HOMELAND SECURITY

http://www.dhs.gov/interagency-security-committee

Interagency Security Committee Standards

FEDERAL HIGHWAY ADMINISTRATION

http://mutcd.fhwa.dot.gov/

Manual on Uniform Traffic Control Devices

NATIONAL FIRE PROTECTION ASSOCIATION

http://www.nfpa.org

NFPA 30, *Flammable and Combustible Liquids Code*

SUPREME HEADQUARTERS ALLIED POWERS EUROPE

SHAPE Document 6160/SHLOFA-059/82, *NATO Approved Criteria and Standards for Tactical and Transport Airfields (6th Addition) (NATO Restricted)*

UNITED STATES ARMY

https://pdc.usace.army.mil

PDC Technical Report 06-08, *Single Degree of Freedom Structural Response Limits for Antiterrorism Design*

PDC Technical Report 10-01, *Conventional Construction Standoff Distances for the Low and Very Low Levels of Protection*

PDC Technical Report 10-02, *Blast Resistant Design Methodologies for Window Systems Designed Statically and Dynamically*

PDC Technical Report 15-01, *Minimum Standoff Distances for Non-Load-Bearing Steel Stud In-Fill Walls*

UNITED STATES AIR FORCE

After Initiative Report, Retrofit and Overpressure Design of Shelters (RODS)