



# Practical Application of Physical Security Criteria

*Presented By:*

*Innovative Engineering Inc.*

*2015 Joint Engineer Training Symposium*

*Society of American Military Engineers*

**Scott L. Weiland PE and Stephen L. Morgan EI**

*August 27, 2015*

# Seminar Overview

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- **Innovative Engineering**
- **Background Information**
  - Terrorism Trends
  - Blast Theory
  - Risk Assessment
- **DoD Minimum Anti-Terrorism Standards for Buildings Unified Facilities Criteria (UFC 4-010-01)**
  - Criteria
  - New Tables & Graphics
  - Practical Application (Example Site Walk Thru)

# Innovative Engineering Inc.

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- **Structural Engineers**
  - Commercial
  - Government
  - Industrial
- **Specialty**
  - Physical Security





# Physical Security

- We Bridge the Gap
- Advanced Training
  - Structural Dynamics
  - CFD
  - Specialized Training
- Services
  - Site Analysis
  - Blast Load Studies
  - Hardening (Blast Design)
  - Progressive Collapse
  - Peer Reviews



# Today's Presenters

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- **Scott L Weiland PE**

- Education
  - BSCE University of Michigan
  - Graduate Studies:
    - San Jose State University
    - Georgia Institute of Technology
  - Anti-Terrorism/Force Protection Security Engineering: Applied Research Associates
  - Design of Blast Resistant Structures: Baker Risk
  - Blast Resistance for Anti-Terrorism: Protective Engineering Consultants
  - Updated UFC 4-010-01: SAME Architectural Practice
  - **Security Engineering: USACE Protective Design Center**
- Registration: PE in 15 States + PR
- Experience
  - 35 Years in Design and Construction
  - **20 Years in ATFP Security Engineering**



# Today's Presenters

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- **Stephen L Morgan EI**
  - Education
    - BSCET, Southern Polytechnic State University
    - Blast Resistance for Anti-Terrorism: Protective Engineering Consultants
    - Blast Resistance by Design: Stone Security Engineering
  - Experience: 10 Years Security Engineering
  - Expertise
    - ATFP Peer Reviews
    - Blast Design
    - Progressive Collapse





# Terrorism

“The unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” Source: U.S. Federal Code

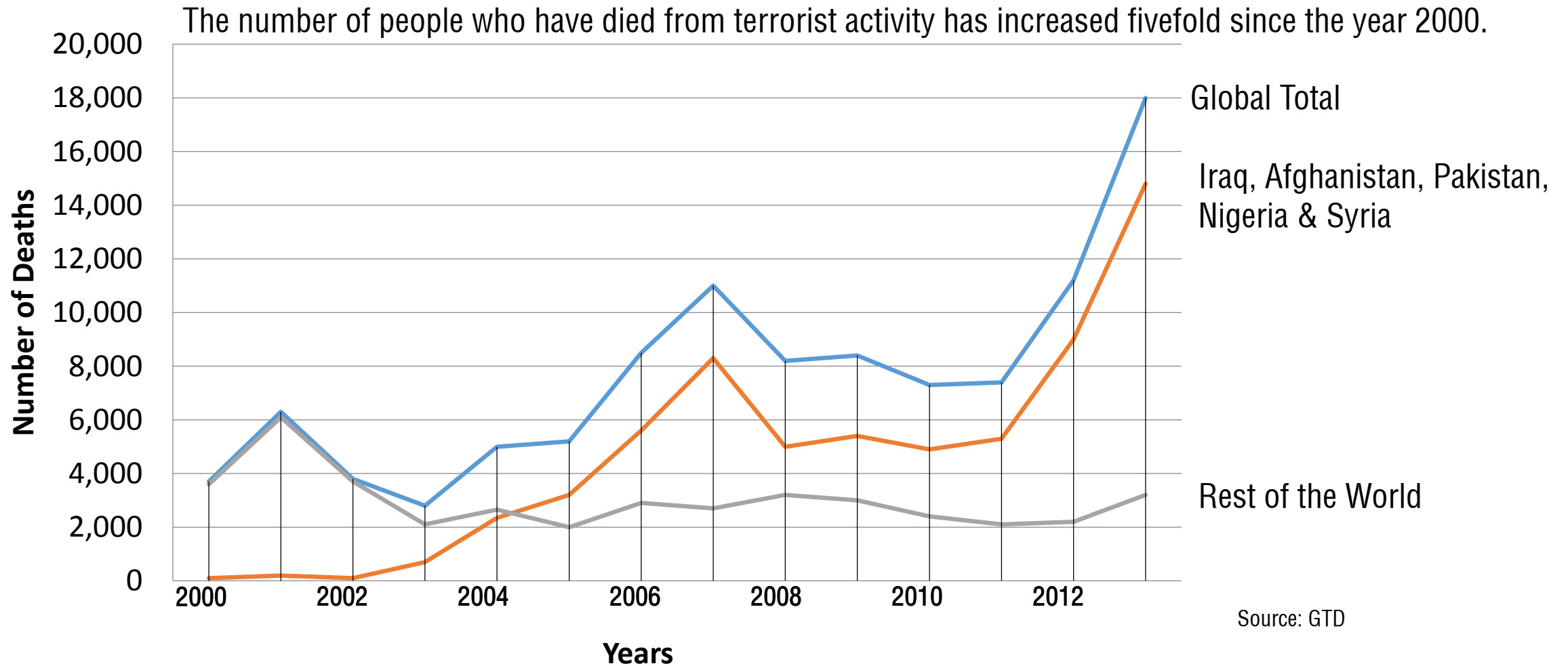


**1773, Boston Tea Party**



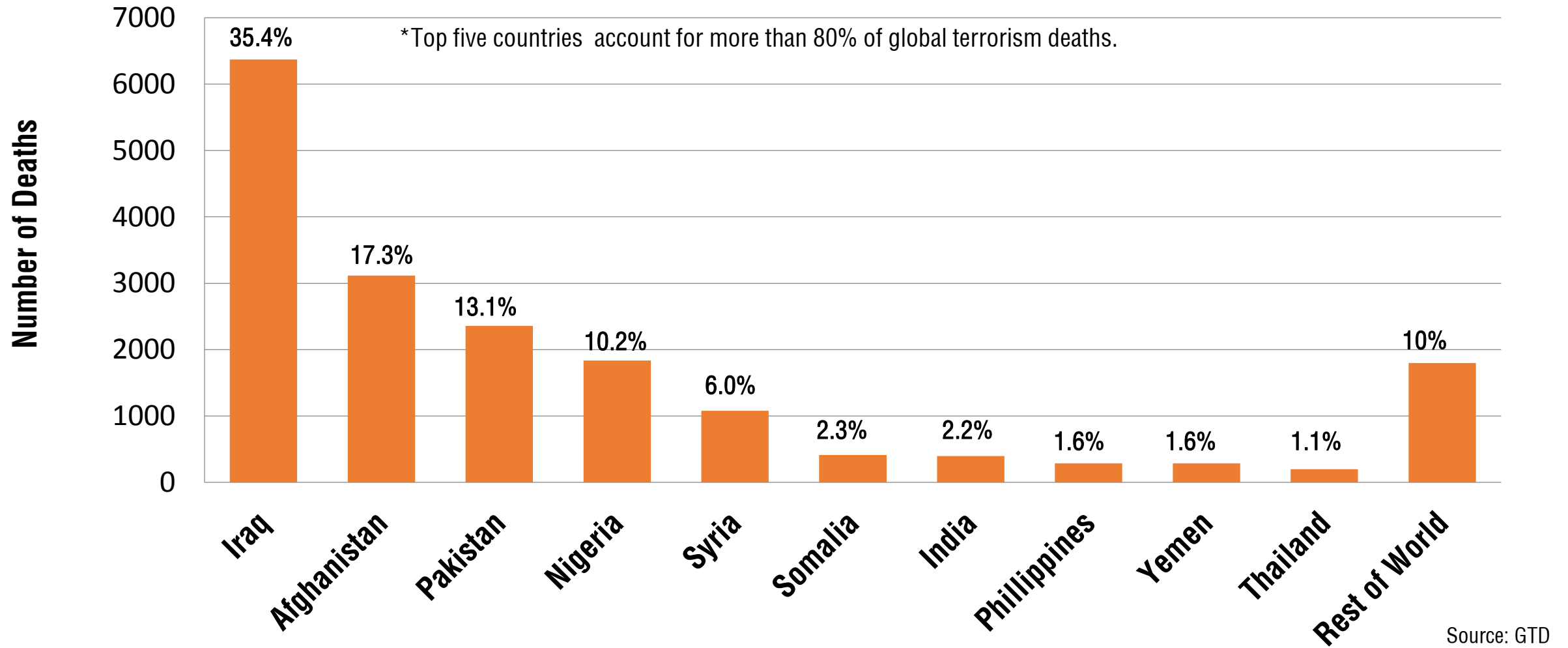
**1800, First Car Bomb**  
Napoleon Bonaparte

# Terrorism Deaths 2000 - 2013

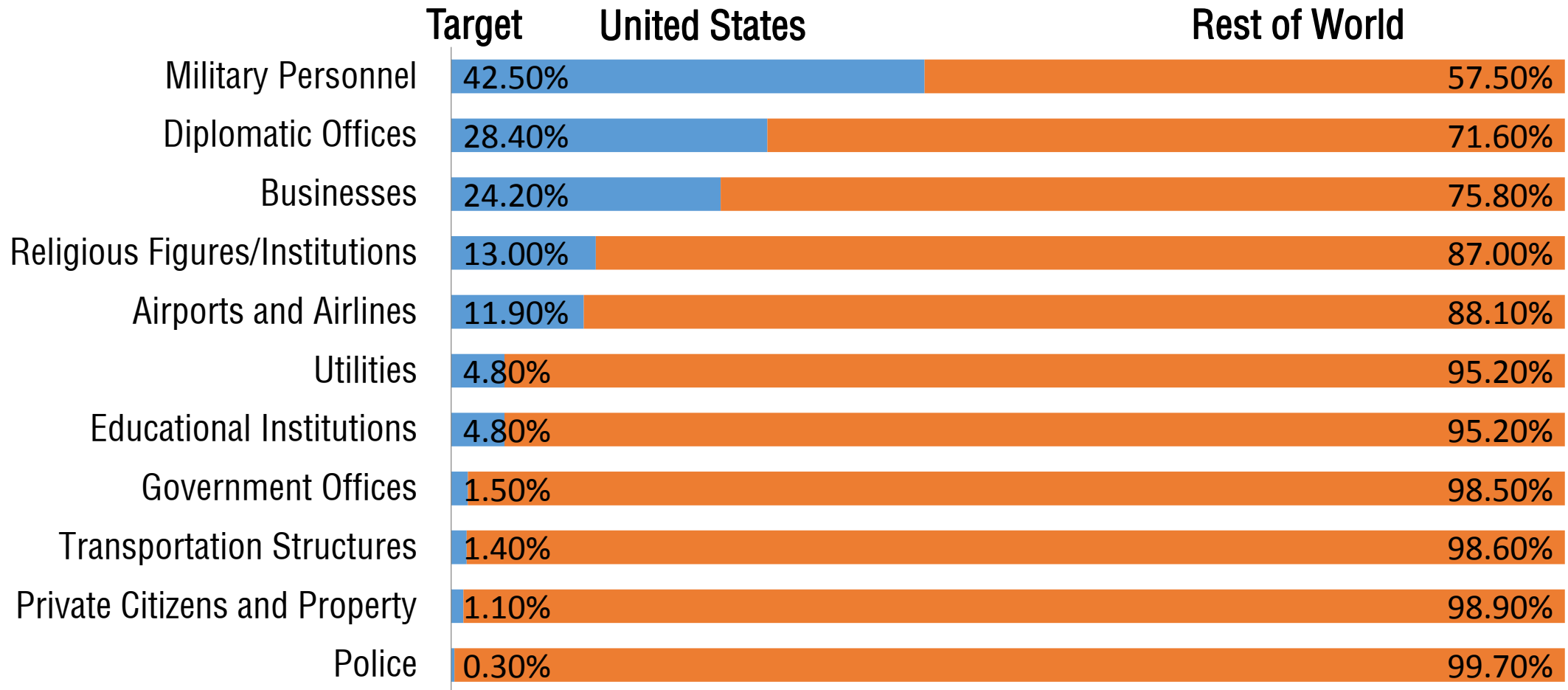




# Terrorism Deaths by Country 2013



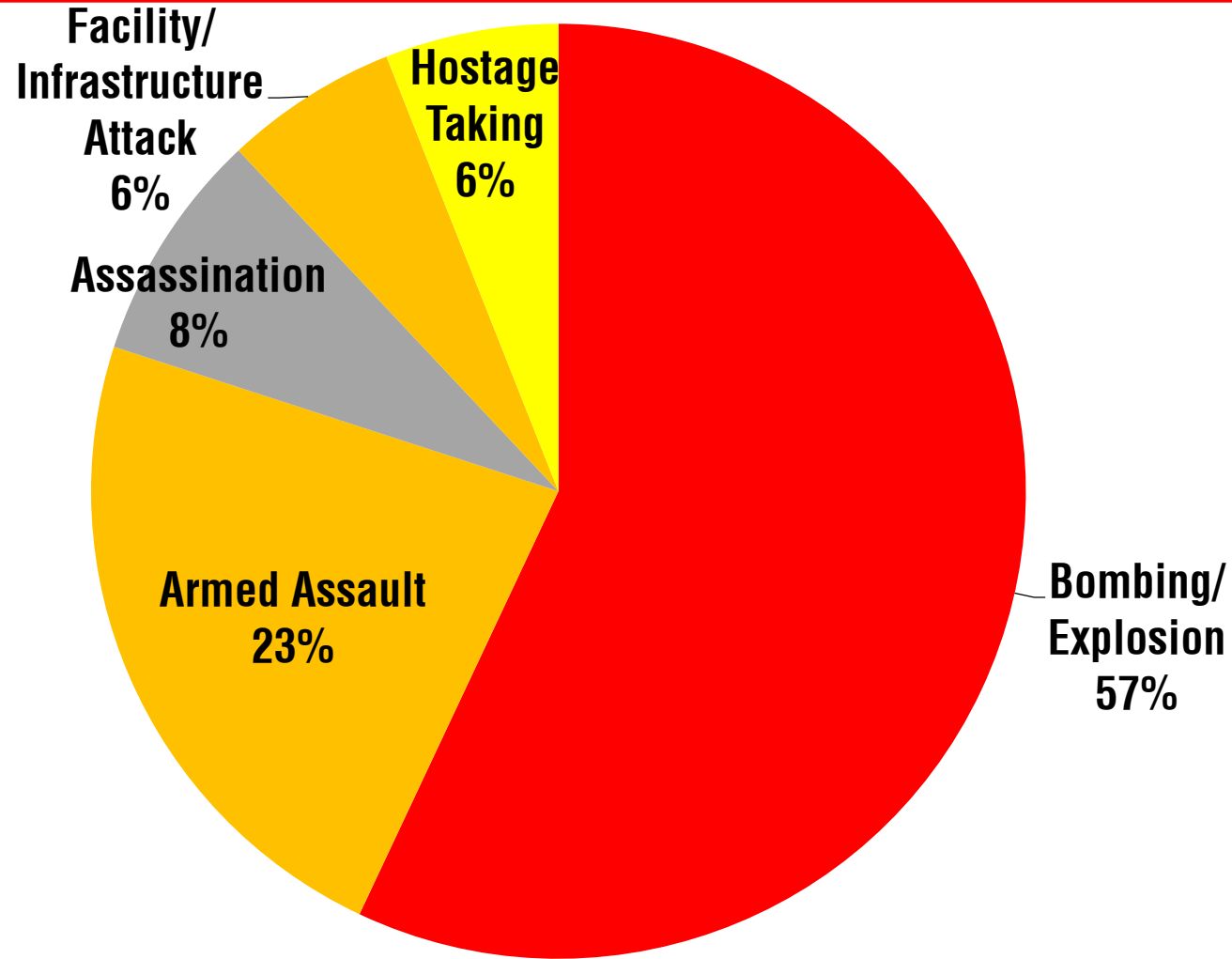
# Terrorist Attacks against Military 1969 - 2009



Source: The Heritage Foundation, Muhlhausen & McNeil

- 43% of all attacks against military institutions are leveled against the US.

# Terrorist Tactics Worldwide, 2013

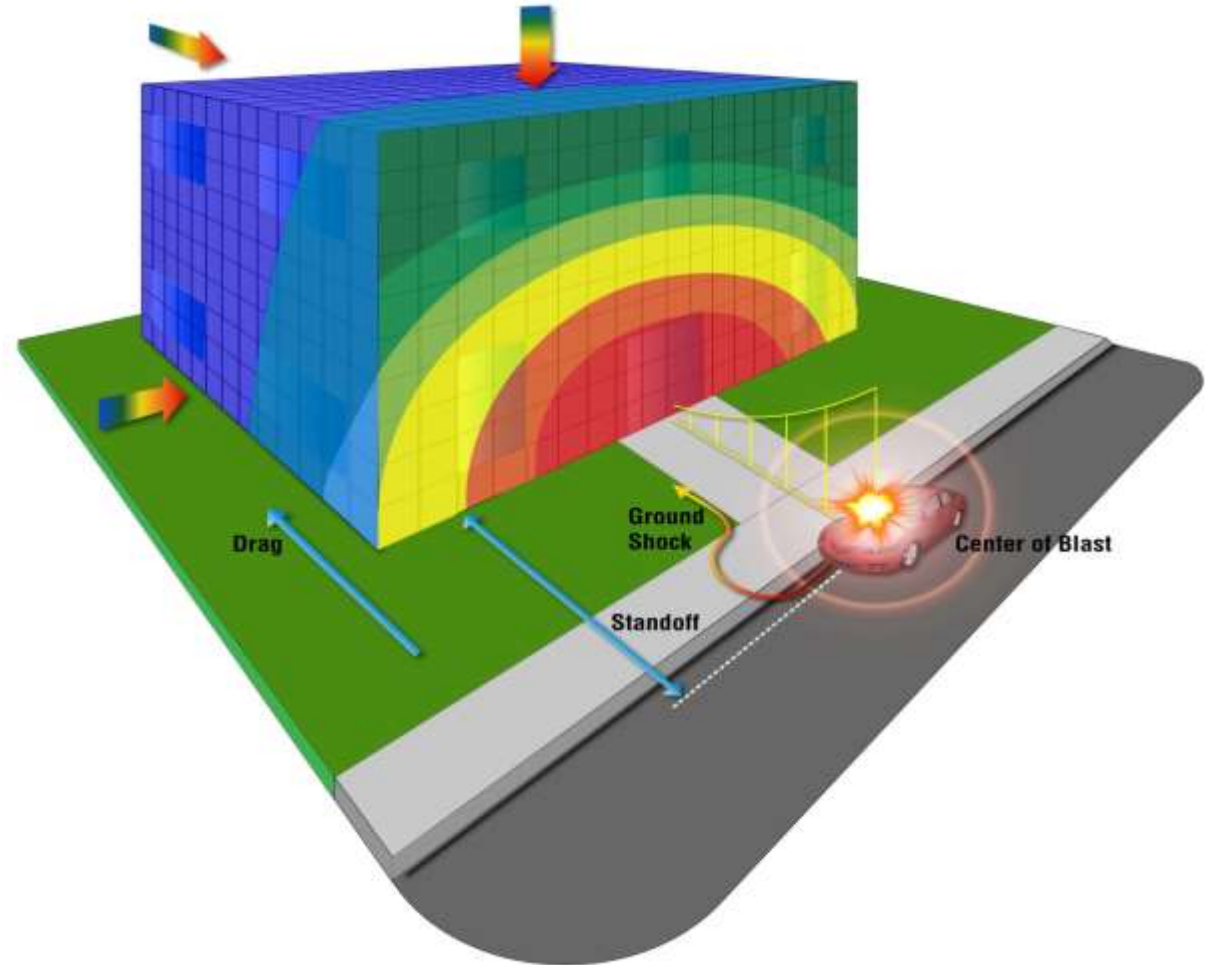


Source: GTD



# Blast Theory - Definitions

- Aggressor
- Tactic – Stationary Bomb
- Standoff
- Shock Wave
- Reflective Pressure
- Side-On/Incident Pressure
- Hardening
- Asset



# Blast Theory - Explosion

- Shock Wave
- Reflected Pressure
- Side-On Pressure
- Rebound



# Blast Theory – Pressure Wave

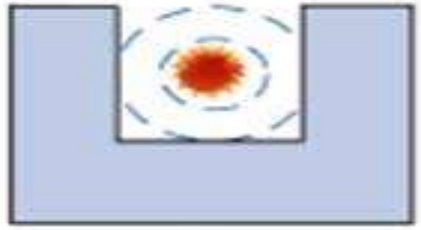
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- Supersonic pressure wave caused by detonation
- Similar to water wave including reflections and refractions and reformation



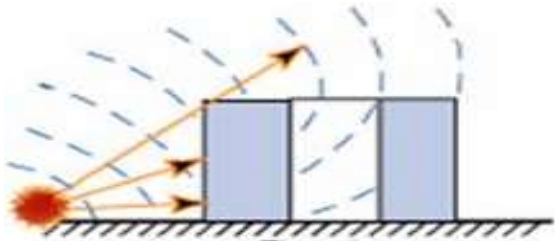
# Blast Theory - Shapes That Affect Blast



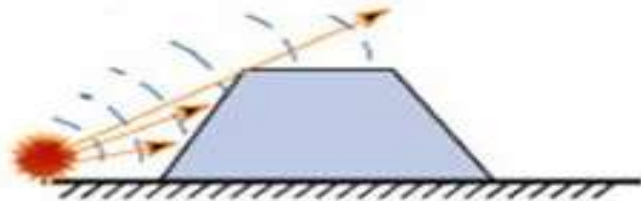
Re-entrant corners



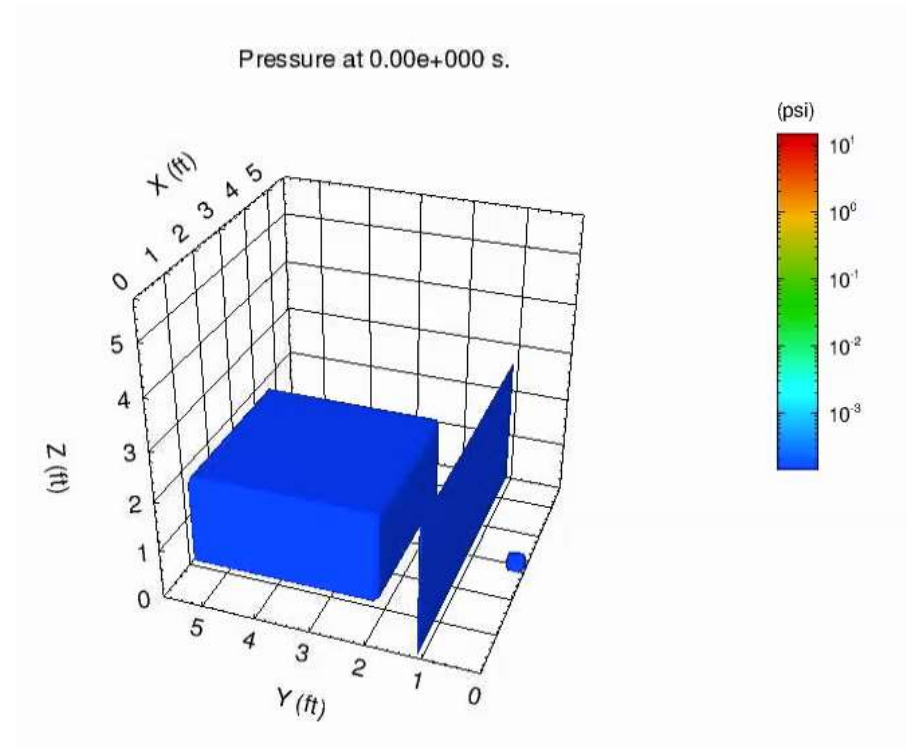
Overhang



Blast Wall

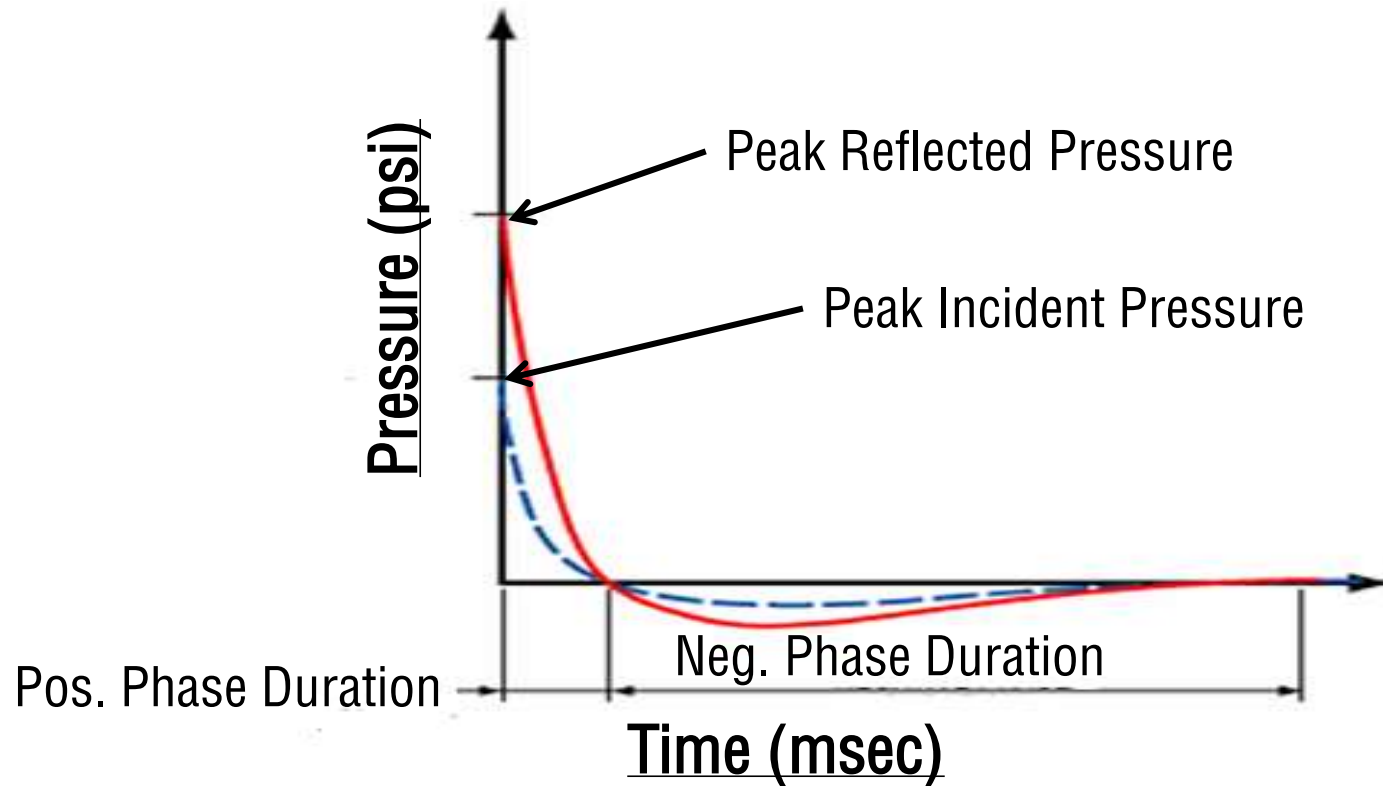


Berm



Blast Wall - CFD

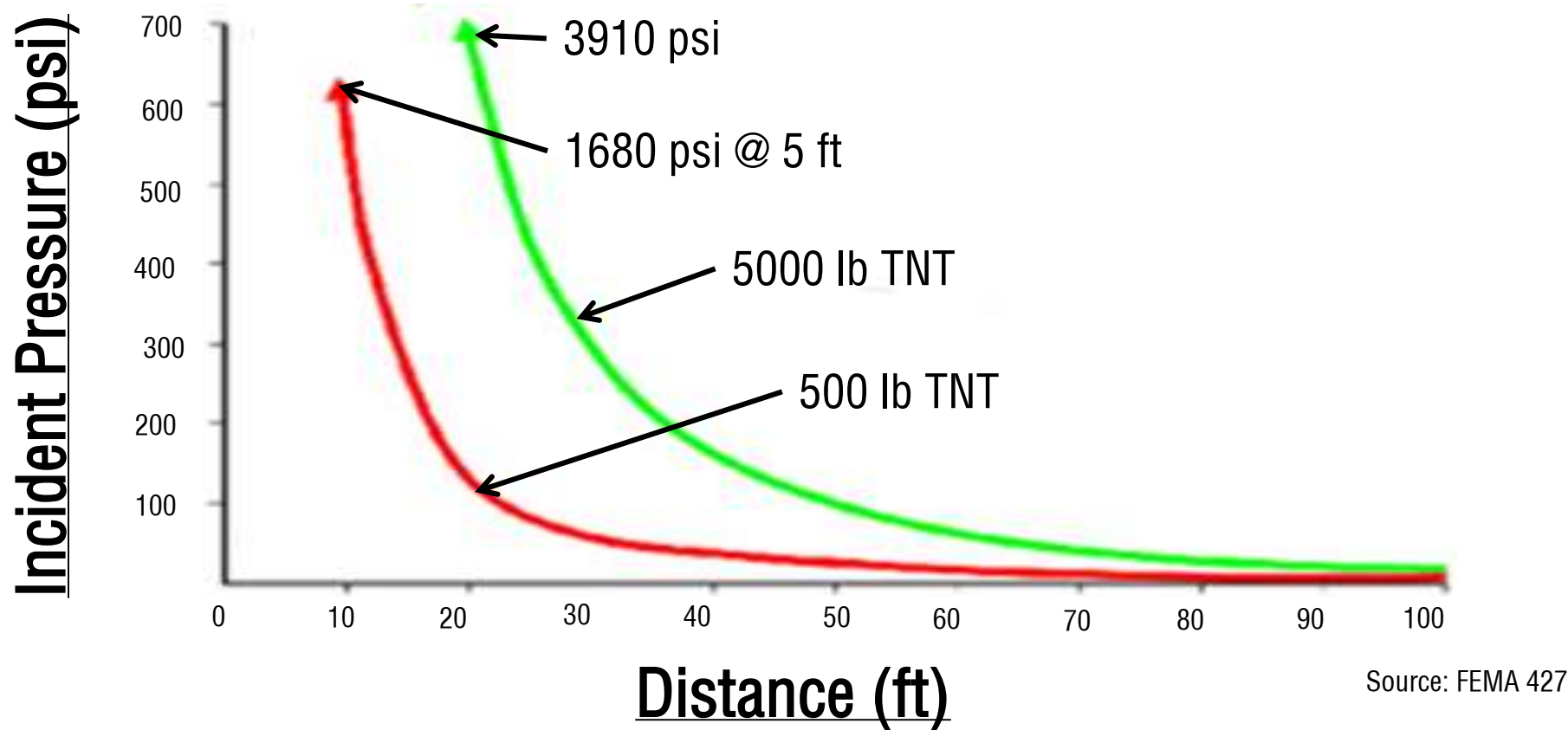
# Blast Theory – Time History



Source: FEMA 427

- Pressures decay exponentially with time.
- Dynamic, non-linear, time history analysis.

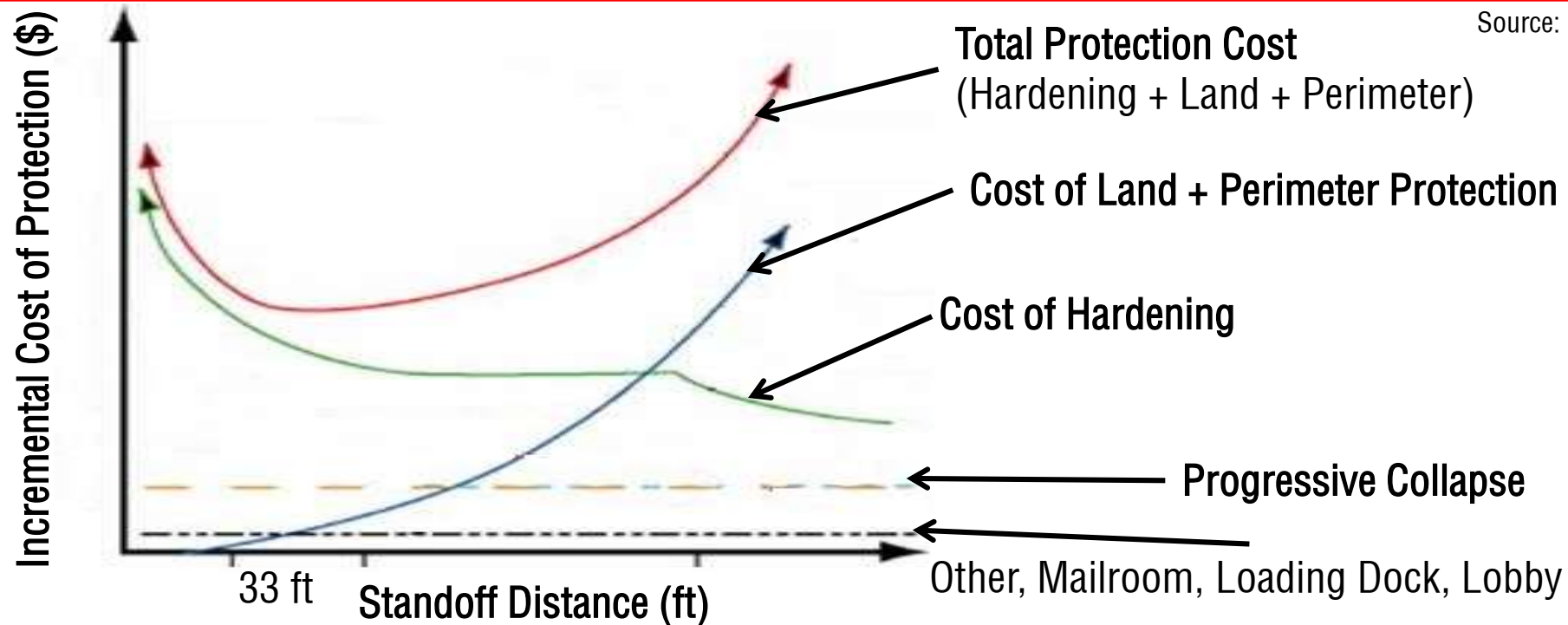
# Blast Theory - Distance



- Pressures decay with the cube of the distance from the explosion.



# Blast Theory - Optimum Standoff



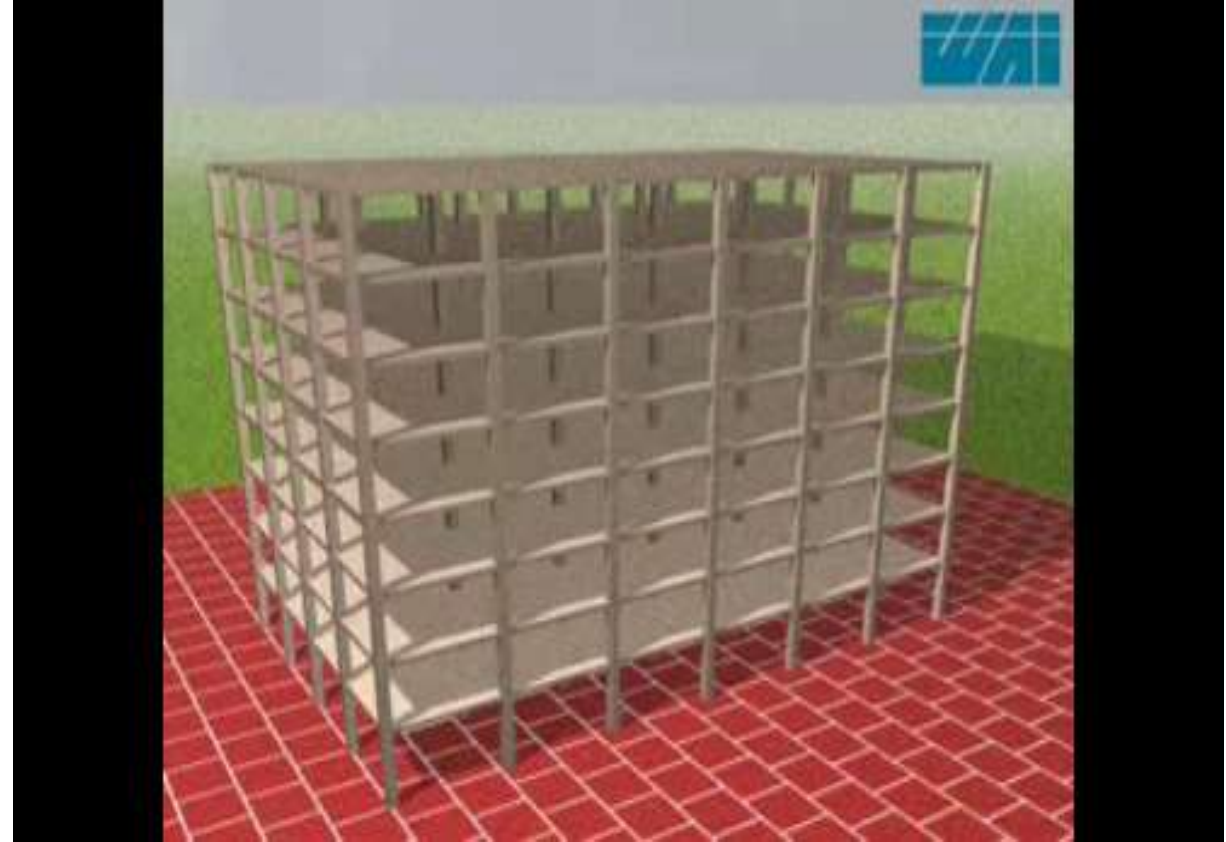
- **Optimize total cost of Hardening + Land + Perimeter**
  - Less stand-off requires more hardening.
  - More stand-off requires more land and perimeter
  - Note Progressive Collapse is threat independent.

# Blast Theory - Progressive Collapse

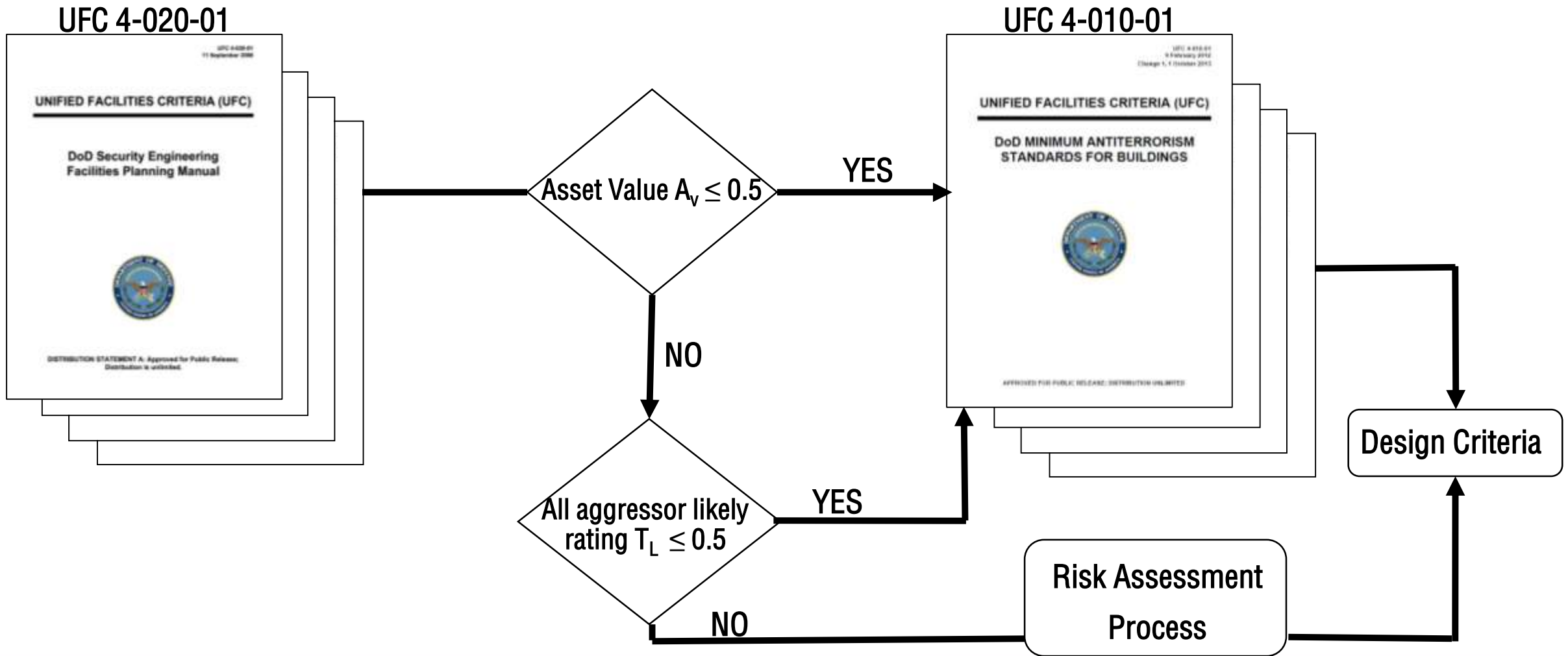
“The spread of an initial local failure from building element to building element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it.”

Source: UFC 4-010-01

- Threat Independent
- Protect by:
  - Redundancy
  - Local Hardening



# Design Criteria Development





# 18 Asset Categories

Assets	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
<b>People</b> (Mission Critical and General Population)	✓	✓
Aircraft and components at aviation facilities	✓	
Ships, boats and other watercraft	✓	
Vehicles and carriage mounted or towed weapons systems and components	✓	
Petroleum, oils and lubricants (POL)	✓	
Arms, ammunition and explosives (AA&E)	✓	
Controlled medical substances	✓	
Comm./elect. test, meas. and diag. equip. and tool kits and night vision devices	✓	
Organizational clothing and individual equipment	✓	

# 18 Asset Categories (Continued)

Assets	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
Subsistence items at commissaries, warehouses and troop issue facilities	✓	
Repair parts at installation supply and direct support units	✓	
Facilities engineering supplies and construction material	✓	
Audiovisual equipment, training devices and sub-caliber devices	✓	
Misc. pilferable assets and currency or negotiable instruments	✓	
Critical infrastructure and industrial equipment	✓	
Controlled cryptographic items	✓	
Sensitive information	✓	
Activities and operations	✓	

# 10 Default Aggressor Types

Aggressor	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
Unsophisticated Criminals	✓	
Sophisticated Criminals	✓	
Organized Criminal Groups	✓	
Vandals	✓	
Extremist Protest Groups	✓	
<b>Domestic Terrorists</b>	✓	✓
<b>International Terrorists</b>	✓	✓
State Sponsored Terrorists	✓	
Saboteurs	✓	
Foreign Intelligence Services	✓	

# 13 Default Tactics

Tactic	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
Moving Vehicle Bomb	✓	
<b>Stationary Bomb</b>	✓	✓
<b>Hand Delivered Bomb</b>	✓	Limited
<b>Indirect Fire Weapon</b>	✓	Limited
<b>Direct Fire Weapon</b>	✓	Limited
Forced Entry	✓	
Covert Entry	✓	
Visual Surveillance	✓	
Acoustical Eavesdropping	✓	
Electronic Emanations Eavesdropping	✓	



# 13 Default Tactics (Continued)

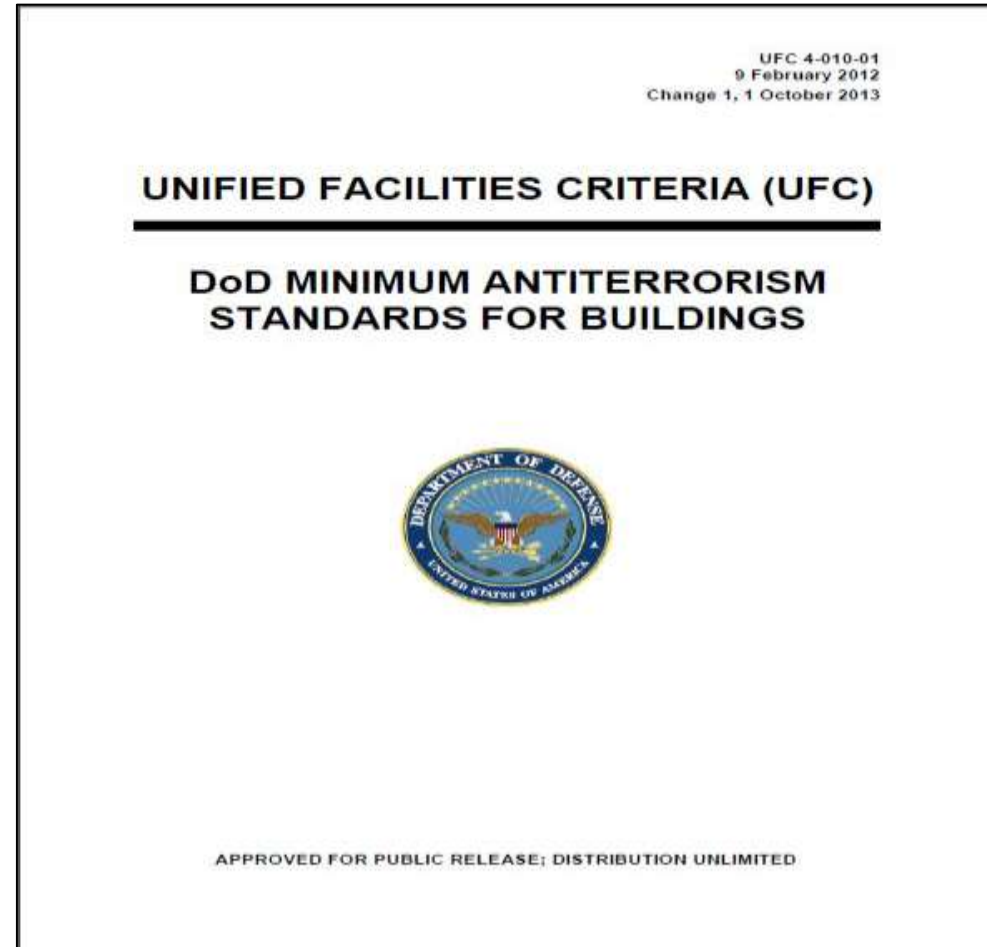
Tactic	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
<b>Airborne Contamination</b>	✓	<b>Limited</b>
Waterborne Contamination	✓	
Waterfront Attack	✓	

# Level of Protection

Aggressor	Facility Planning Manual (UFC 4-020-01)	Minimum Antiterrorism Standards for Buildings (UFC 4-010-01)
Very High	✓	
High	✓	
Medium	✓	
<b>Low</b>	✓	✓
<b>Very Low</b>	✓	✓

# DoD Minimum ATFP Criteria

- DoD Design Criteria
- Combination of performance and prescriptive requirements.
- Simplified graphics and tables.





# Questions?

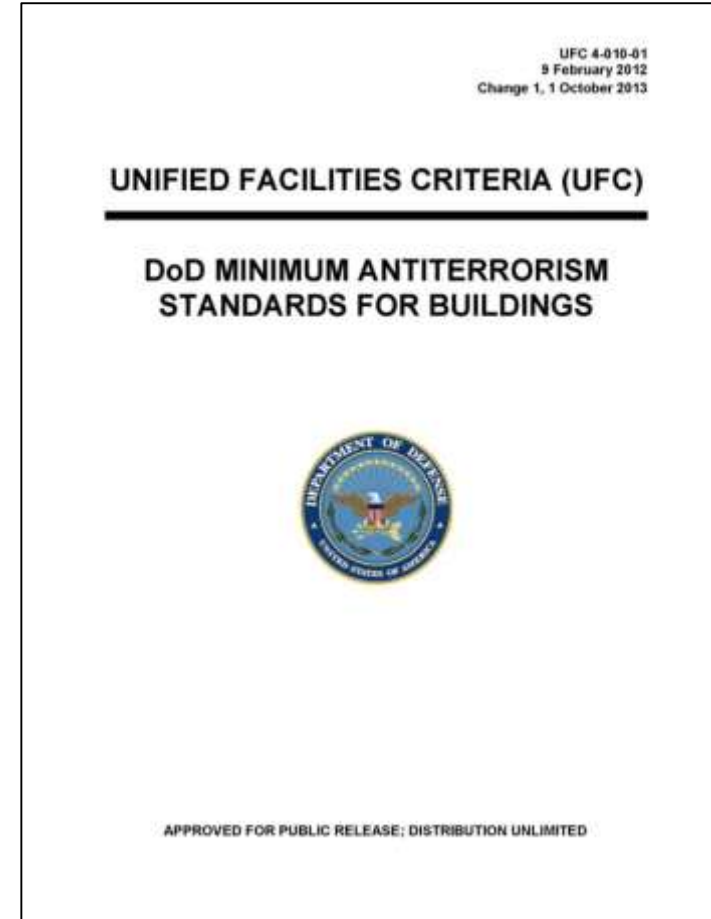
**Next: DoD Minimum Antiterrorism Standards for Buildings**

**Stephen L Morgan EI**

# UFC 4-010-01 Content Overview

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- Intent of UFC 4-010-01
- Recent Changes
- Applicability
- Levels of Protection
- Building Categories
- Threat Definition
- Standoff Distance
- Standards within the UFC
- Recommendations
- Expeditionary Structures
- Examples
- Risk Reduction Measures





# Intent of UFC 4-010-01

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- **Minimize mass casualties** in buildings or portions of buildings owned, leased, privatized or otherwise occupied, managed, or controlled by or for the DoD in the event of a terrorist attacks
- **Provides baseline – minimum standards** to address anti-terrorism force protection for DoD buildings
- **Cost effective means** of protecting DoD personnel from a wide range of threats posed by terrorist
- **Allows implementation of the standard to vast quantity of assets** controlled by DoD over time in a more cost effective way

# Recent Changes to UFC 04-010-01

- Minimum and Conventional Construction Standoff Distance now more clearly defined based on wall composition and loading
- Translucent panels now treated as wall assembly (Standard 1) and no longer excluded from Standard 10
- Parking Structure Exemption
  - Parking structures are exempt except where areas built into the structure meet the definition of inhabited buildings
- HVAC replacement or upgrade projects are now included in the standard
  - Standards 16 and 18 apply regardless of cost triggers

Table B-1 Standoff Distances for New and Existing Buildings

Location	Building Category	Standoff Distance Requirements			
		Applicable Level of Protection	Conventional Construction Standoff Distance	Minimum Standoff Distance <sup>(1)</sup>	Applicable Explosive Weight <sup>(2)</sup>
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Billeting and High Occupancy Family Housing	Low	45 m <sup>(3)</sup> (148 ft.)	25 m <sup>(3)</sup> (82 ft.)	I
	Primary Gathering Building	Low	45 m <sup>(3)(4)</sup> (148 ft.)	25 m <sup>(3)(4)</sup> (82 ft.)	I

Table B-1 Standoff Distances for New and Existing Buildings

Distance to:	Building Category	Standoff Distances				
		Applicable Level of Protection	Conventional Construction Standoff Distance		Minimum Standoff Distance <sup>(2)</sup>	Applicable Explosive Weight <sup>(2)</sup>
			Load Bearing Walls <sup>(1)</sup>	Non-Load Bearing Walls <sup>(1)</sup>		
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Billeting and High Occupancy Family Housing	Low	A	C	20 ft (6 m)	I
	Primary Gathering Building	Low	A	C	20 ft (6 m)	I

# Applicability of UFC 04-010-01

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- **All new non-exempt buildings shall comply with the UFC including**
  - DoD Occupied Buildings
  - Non DoD Tenant Buildings on DoD property
  - National Guard Buildings
  - Visitor Centers and Museums
  - Visitor Control Centers at entry control Facilities/Access control points
  - Expeditionary

# Applicability of UFC 04-010-01

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- **Existing Buildings shall comply with the UFC when Triggered by the following**
  - **Major Investment** – When renovation exceeds 50% of the total plant replacement value ,excluding costs to meet this standard e.g. using blast windows vs non-blast windows
  - **Change of Occupancy** – e.g. From Inhabited to Primary Gathering
  - **Window, Skylight and Glazed Door Replacement and Installation**
  - **Roadway Improvement Projects** that change standoff distances from the original building design

# Applicability of UFC 04-010-01

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- **Building Additions**
  - Includes the addition **AND** entire building if addition area is greater than 50% of the existing building
- **Leased Buildings**
  - All new and renewing leases where DoD occupies at least 25% of the building area.
  - If off installation building shall conform with Interagency Security Committee standards
- **DoD Purchase of Existing Buildings**
- **Projects under previous versions of the standard do not need to be reprogrammed to meet the current standard if they are beyond 35% complete or passed the RFP stage for Design/Build projects**



# Exemptions of UFC 04-010-01

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- **Buildings exempted from all provisions in the UFC**
  - Low occupancy family housing
  - Low occupancy buildings
  - Fisher houses with 24 units or less
  - Town Centers
  - Enhanced Use leases
  - Transitional Structures and spaces
  - Temporary relocatable buildings
  - Construction administration structures

# Exemptions of UFC 04-010-01

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- **Exempt from Roadway and Standoff Provisions**
  - Gas stations and car care centers
  - Military protective construction
  - Stand-alone franchised fast food operations
  - Stand-alone shopettes, minimarts and similarly sized commissaries
  - Small stand-alone commercial, bank and pharmacy facilities
  - Parking structures

# Levels of Protection

- Below Anti-Terrorism Standards –NOT a level of protection and never a design goal
- Very Low – heavy damage, onset of collapse
- Low – moderate damage, progressive collapse will not occur
- Medium and High
  - Outside the scope of the UFC
  - Refer to UFC 4-020-01 DoD Security Engineering Facilities Planning Manual

UFC 4-010-01  
9 February 2012  
Change 1, 1 October 2013

Table 2-1 Levels of Protection – New and Existing Buildings

Level of Protection	Potential Building Damage/Performance <sup>1</sup>	Potential Door and Glazing Hazards <sup>1*</sup>	Potential Injury
Below AT standards <sup>1</sup>	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 IV)	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 II)	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 <sup>5</sup>	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 shivers. (Minimal hazard and No Hazard ratings). * Doors will be operable but will have permanent deformations. (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 <sup>6</sup>	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

# Building Categories

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- **Billeting** - Any building or portion of building in which 11 or more DoD personnel are routinely housed regardless of population density
- **High Occupancy Family Housing** – DoD buildings used as quarters for DoD personnel and their departments with 13 or more units per building.
- **Primary Gathering** - Buildings sheltering DoD personnel routinely occupied by 50 or more and a populations density of more than 1 person/430 SF
- **Inhabited** – Buildings sheltering DoD personnel routinely occupied by 11 or more and a populations density of more than 1 person/430 SF
- **Low Occupancy** – Buildings sheltering DoD personnel routinely occupied by fewer than 11 or population density less than 1 person/430 SF
- **Historic Buildings**
  - Determine adverse affects caused by standard implementation
  - Historic status does not negate the implementation of the standard

# Threat Definition

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- **Types of Threats**

- **Vehicle Bombs – Charge Weight I or II**
- **Waterborne Vessel Bombs – Charge Weight I or II at perimeter**
- **Placed Bombs – Charge Weight II**
- **Mail Bombs (No size defined in this standard)**
- **Indirect Fire Weapons Charge Weight III**
- **Direct Fire Weapons – small arms or shoulder fired rockets**
- **Chemical, Biological and Radiological Weapons**
- **Explosive Weights for each charge weight can be found in UFC 4-010-02 (FOUO)**
- **Charge Weight I is MUCH higher than Charge Weight II**



# Threat Definition

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- **Assumptions**
  - Charge Weight I threats **will be detected at the controlled perimeter**
  - Charge Weight II threats **can enter the controlled perimeter.**
  - **Installation policies and procedure are in place to support the anti-terrorism security measures**

# Standards Within UFC 4-010-01

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- Standard 1 – Standoff Distance
- Standard 2 – Unobstructed Space
- Standard 3 – Drive Up/Drop Off Areas
- Standard 4 – Access Roads
- Standard 5 – Parking Beneath Building or on Roof Tops
- Standard 6 – Progressive Collapse
- Standard 7 – Structural Isolation
- Standard 8 – Building Overhangs and Breezeways
- Standard 9 – Exterior Masonry Walls
- Standard 10 – Windows and Skylights
- Standard 11 - Building Entrance Layout
- Standard 12 – Exterior Doors
- Standard 13 – Mail Rooms and Loading Docks
- Standard 14 – Roof Access
- Standard 15 – Overhead Mounted Architectural Features
- Standard 16 –Air Intakes
- Standard 17 – Mail Room and Loading Dock Ventilation
- Standard 18 Emergency Air Distribution
- Standard 19 –Equipment Bracing
- Standard 20 –Under Building Access
- Standard 21 – Mass Notification

# Standoff Distance – Standard 1

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- **What is Standoff Distance?**
  - **Minimum Standoff Distance** – The smallest permissible standoff distance for new construction regardless of analysis. For existing buildings standoff distances less than the minimum used for new construction may be used if analysis shows the level of protection can be met
  - **Conventional Construction Standoff Distance** – Standoff distance at which conventional construction may be used for building components without specific analysis. However windows and doors must always be analyzed for blast effects
  - **Standoff distances are measured to Controlled perimeters, parking, roadways and trash containers**

# Standoff Distance – Standard 1

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- **What is Conventional Construction?**

- Parts of a building not specifically designed to resist weapons or explosive effects. Windows, doors and their respective support system always require analysis at their respective standoff distance and associated charge weight
- This construction is not exempt from building code requirements for gravity, wind, seismic loading

# Conventional Construction Assumptions

Table 2-3 Conventional Construction Parameters

Wall or Roof Type <sup>(1)</sup>	Analysis Assumptions <sup>(2, 9)</sup>						
	Sections	Span	Spacing	Support Condition	Supported Weight <sup>(1)</sup>	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 <sup>2</sup> )	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 <sup>2</sup> )	N/A	875 psi (6 MPa)
Steel Studs – Brick Veneer <sup>(2)</sup>	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 <sup>2</sup> )	N/A	50,000 psi (345 MPa)
Steel Studs – EIFS <sup>(3)</sup>	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 <sup>2</sup> )	N/A	50,000 psi (345 MPa)
Metal Panels <sup>(6)</sup> (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 <sup>2</sup> )	N/A	33,000 psi (228 MPa)
Girts <sup>(6)</sup> (in wall or roof construction)	6Z3 & 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 <sup>2</sup> )	N/A	50,000 psi (345 MPa)
Reinforced Concrete <sup>(7)</sup>	≥ 6 in (≥ 150 mm)	12 – 20 ft (3.7 – 6 m)	N/A	S-S, One way flexure	10 psf (49 kg/m <sup>2</sup> )	≥ 0.0015	3,000 psi (21 MPa)
Unreinforced Masonry <sup>(4, 8)</sup>	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 <sup>2</sup> )	0	1,500 psi (10 MPa)

Table 2-3 Conventional Construction Parameters

Wall or Roof Type <sup>(1)</sup>	Analysis Assumptions <sup>(2, 9)</sup>						
	Sections	Span	Spacing	Support Condition	Supported Weight <sup>(1)</sup>	Reinforcement Ratio	Min. Static Material Strength
Reinforced Masonry <sup>(7, 8)</sup>	8 – 12 in (200 – 300 mm)	10 – 14 ft (3 – 4.3 m) 12 ft (3.7 m) 14 ft (4.3 m)	N/A	S-S, One way flexure	10 psf (49 kg/m <sup>2</sup> )	0.0005 – 0.0030	1,500 psi (10 MPa)
European Block <sup>(3, 4)</sup>	6 – 8 in (150 – 200 mm)	10 – 12 ft (3 – 3.7 m)	N/A	S-S, Brittle Flexure	10 psf (49 kg/m <sup>2</sup> )	0	1,800 psi (12 MPa)
Concrete Roofs <sup>(7)</sup>	4 – 12 in (100 – 300 mm)	6 ft (1.8 m)	N/A	F-S	15 psf (73 kg/m <sup>2</sup> )	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 (9.1 m)	4 – 8 ft (1.2 – 2.4 m)	S-S	15 – 90 psf (73 – 439 kg/m <sup>2</sup> )	N/A	50,000 psi (345 MPa)

- Other types of construction other than that shown in this table may be permissible subject to validation by the designer of record.
- See PDC Technical Report 10-01 for details on the analysis assumptions and material properties.
- 1) 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 1/1.
- Unreinforced masonry must have adequate lateral support at the top and bottom.
- Weight supported by the wall that moves through the same deflection as the wall, not including self-weight of the component.
- 1) For walls or roofs built using metal panels and girts, use the greater of the standoffs for the metal panel and the girt 1/1.
- 1) Reinforcing steel is 60,000 psi (414 MPa) tensile strength 1/1.
- 1) Concrete Masonry Units (excluding European block) are medium weight (120 pcf / 1922 kg/m<sup>3</sup>) 1/1.
- 1) Shear will need to be checked when using higher than minimum material strengths. 1/1
- S-S = Simple - Simple Supports F-S = Fixed - Simple Supports

# Standoff Distance – Standard 1

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- **Important Site Features**

- **Controlled perimeter** – a physical boundary at which vehicle access is controlled, generally at the perimeter of an installation or high water mark, where threats of charge weight I can be searched and detected.
- **Unobstructed Space**
  - Space that extends from the building walls out to the conventional construction standoff distance.



# Standoff Distance – Standard 1

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- **Parking**

- New buildings parking never permitted within minimum standoff
- Existing Buildings parking only permitted within minimum standoff if LOP can be achieved through hardening
- Controlled parking for existing buildings can be within CCSD without hardening provided controlled parking with ID check is provided at or beyond the CCSD. Pedestrian access control must also be provided to these parking areas (e.g. Fencing)
- Parking of government and emergency vehicles that never leave restricted access areas are allowed within the minimum standoff
- Driving lanes within Parking Areas of existing buildings may be closer than parking spaces located at the required standoff, but vehicles may not be left unattended. Standoff for this condition is the nearest parking space. This is not allowed for new buildings

# Standoff Distance – Standard 1

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- **Roadways**

- New and existing buildings roadways never within minimum standoff distance

- **Trash Containers**

- Never within minimum standoff distance
- If more that two sides or within the unobstructed space, container must be 5 sided and prevent concealment of an object 6 inches or greater in height or width

- **Adjacent Existing Buildings**

- Where new or existing buildings designed in accordance with this standard including parking, roadways and trash containers are adjacent to an existing inhabited building, the standoff distance from the new or existing building project to the adjacent existing building shall be in accordance with Standard 1. If these distances can not be met, the adjacent existing building must be analyzed for the new standoff distance

# Standoff Distance Tables B-1 and B-2

Table B-1 Standoff Distances for New and Existing Buildings

Distance to:	Building Category	Standoff Distances				
		Applicable Level of Protection	Conventional Construction Standoff Distance		Minimum Standoff Distance <sup>(2)</sup>	Applicable Explosive Weight <sup>(3)</sup>
			Load Bearing Walls <sup>(1)</sup>	Non-Load Bearing Walls <sup>(1)</sup>		
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter	Billiting and High Occupancy Family Housing	Low	A	C	20 ft (6 m)	I
	Primary Gathering Building	Low	A	C	20 ft (6 m)	I
	Inhabited Building	Very Low	B	D	20 ft (6 m)	I
Parking and Roadways within a Controlled Perimeter	Billiting and High Occupancy Family Housing	Low	E	G	13 ft (4 m)	II
	Primary Gathering Building	Low	E	G	13 ft (4 m)	II
	Inhabited Building	Very Low	F	H	13 ft (4 m) /1/	II
Trash Containers	Billiting and High Occupancy Family Housing	Low	E	G	13 ft (4 m)	II
	Primary Gathering Building	Low	E	G	13 ft (4 m)	II
	Inhabited Building	Very Low	F	H	13 ft (4 m) /1/	II

1. See Table B-2 for standoff distances.

2. For new construction, standoff distances less than those in this column are not allowed for new buildings regardless of analysis or hardening. For existing buildings that are constructed / retrofitted to provide the required level of protection, standoffs less than those in this column are allowed, but discouraged.

3. See UFC 4-010-02, for the specific explosive weights (pounds / kg of TNT) associated with explosive weights I and II. UFC 4-010-02 is For Official Use Only (FOUO).

Table B-2 Conventional Construction Standoff Distances

Wall Type <sup>(1), (1), (1), (1)</sup>	Column Letter							
	Without Controlled Perimeter Applicable Explosive Weight <sup>(3)</sup>				Within Controlled Perimeter Applicable Explosive Weight II <sup>(3), (3), (3)</sup>			
	Load Bearing Walls		Non-Load Bearing Walls		Load Bearing Walls		Non-Load Bearing Walls	
	A PG & BIL LLOP	B INHAB VLLOP	C PG & BIL LLOP	D INHAB VLLOP	E PG & BIL LLOP	F INHAB VLLOP	G PG & BIL LLOP	H INHAB VLLOP
Wood Studs – Brick Veneer	105 ft (32 m)	105 ft (32 m)	79 ft (24 m)	66 ft (20 m)	36 ft (11 m)	36 ft (11 m)	23 ft (7 m)	16 ft (5 m)
Wood Studs – EIFS	207 ft (63 m)	207 ft (63 m)	164 ft (50 m)	141 ft (43 m)	86 ft (26 m)	86 ft (26 m)	66 ft (20 m)	56 ft (17 m)
Metal Studs – Brick Veneer	187 ft (57 m)	187 ft (57 m)	207 ft <sup>(3)</sup> (63 m)	187 ft <sup>(3)</sup> (57 m)	75 ft (23 m)	75 ft (23 m)	82 ft <sup>(3)</sup> (25 m)	75 ft <sup>(3)</sup> (23 m)
Metal Studs – EIFS	361 ft (110 m)	361 ft (110 m)	420 ft <sup>(3)</sup> (128 m)	361 ft <sup>(3)</sup> (110 m)	151 ft (46 m)	151 ft (46 m)	167 ft <sup>(3)</sup> (51 m)	151 ft <sup>(3)</sup> (46 m)
Metal Panels	n/a <sup>(2)</sup>	n/a <sup>(2)</sup>	151 ft (46 m)	108 ft (33 m)	n/a <sup>(2)</sup>	n/a <sup>(2)</sup>	56 ft (17 m)	39 ft (12 m)
Girts	n/a <sup>(2)</sup>	n/a <sup>(2)</sup>	115 ft (35 m)	59 ft (18 m)	n/a <sup>(2)</sup>	n/a <sup>(2)</sup>	23 ft (7 m)	16 ft (5 m)
Reinforced Concrete	66 ft (20 m)	66 ft (20 m)	26 ft (8 m)	20 ft (6 m)	16 ft (5 m)	16 ft (5 m)	13 ft (4 m)	13 ft (4 m)
Unreinforced Masonry <sup>(4)</sup>	262 ft (80 m)	262 ft (80 m)	125 ft (38 m)	33 ft (10 m)	80 ft (24 m)	80 ft (24 m)	26 ft (8 m)	16 ft (5 m)
Reinforced Masonry	86 ft (26 m)	86 ft (26 m)	30 ft (9 m)	20 ft (6 m)	30 ft (9 m)	30 ft (9 m)	13 ft (4 m)	13 ft (4 m)
European Block	164 ft (50 m)	164 ft (50 m)	59 ft (18 m)	30 ft (9 m)	39 ft (12 m)	39 ft (12 m)	23 ft (7 m)	16 ft (5 m)
1/1 Roof Construction in Table 2-3 / 1/	20 ft (6 m)				13 ft (4 m)			

# Combined Standoff Table – Load Bearing

Conventional Construction Standoff Distance Table - Load Bearing Construction <sup>(3,8)</sup>																
Distance to	Building Category	Applicable Level Of Protection	Explosive Weight <sup>(2)</sup>	Minimum Standoff Distance (FT) <sup>(1)</sup>	Conventional Construction Standoff Distances (FT)											
					Wood Studs - Brick Veneer	Wood Studs- EIFS	Metal Studs - Brick Veneer	Metal Studs- EIFS	Metal Panels	Girts	Reinforced Concrete	Unreinforced Masonry <sup>(6)</sup>	Reinforced Masonry	European Block	Concrete Roofs	Metal Roofs
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter <sup>(7)</sup>	Billeting and High Occupancy Family Housing	Low	I	20	105	207	187	361	NA <sup>(4)</sup>	NA <sup>(4)</sup>	66	262	86	164	20	20
	Primary Gathering Building	Low	I	20	105	207	187	361	NA <sup>(4)</sup>	NA <sup>(4)</sup>	66	262	86	164	20	20
	Inhabited Building	Very Low	I	20	105	207	187	361	NA <sup>(4)</sup>	NA <sup>(4)</sup>	26	262	86	164	20	20
Parking and Roadways within a Controlled Perimeter <sup>(7)</sup>	Billeting and High Occupancy Family Housing	Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
	Primary Gathering Building	Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
	Inhabited Building	Very Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
Trash Containers	Billeting and High Occupancy Family Housing	Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
	Primary Gathering Building	Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
	Inhabited Building	Very Low	II	13	36	86	75	151	NA <sup>(4)</sup>	NA <sup>(4)</sup>	16	80	30	39	13	13
Footnotes:																
1. For new construction, standoff distances less than those in this column are not allowed for new buildings regardless of analysis or hardening. For existing buildings that are constructed / retrofitted to provide the required level of protection, standoffs less than those in this column are allowed, but discouraged.																
2. See UFC 4-010-02, for the specific explosive weights (pounds / kg of TNT) associated with explosive weights I and II. UFC 4-010-02 is For Official Use Only (FOUO).																
3. Refer to Table 2-3 for details on the analysis assumptions and material properties for these wall types. Note that window and door construction will need to be heavier and more expensive when standoff distances are less than 82 feet (25 meters) for Explosive Weight I and 33 feet (10 meters) for Explosive Weight II. 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																
4. Metal panels and girts are not considered primary structural members. Where they are used in the same wall, use the applicable standoff that is the greatest of the two components.																
5. Non-load bearing steel studs are assumed to have slip-track connections. Closer distances may be obtained through non-standard detailing and analysis.																
6. Only used for analysis of existing structures. Not allowed for new construction.																
7. Note that standoff distances less than 43 feet (13 meters) for Explosive Weight I and 23 feet (7 meters) for Explosive Weight II will require dynamic analysis for windows because lesser distances are outside the range of ASTM F2248.																
8. Note that all of the construction included in this table must also be checked for loading conditions specified by other applicable structural criteria.																

# Combined Standoff Table – Non-Load Bearing

Conventional Construction Standoff Distance Table -Non-Load Bearing Construction <sup>(3,8)</sup>																
Distance to	Building Category	Applicable Level Of Protection	Explosive Weight <sup>(2)</sup>	Minimum Standoff Distance (FT) <sup>(1)</sup>	Conventional Construction Standoff Distances (FT)											
					Wood Studs - Brick Veneer	Wood Studs- EIFS	Metal Studs - Brick Veneer	Metal Studs- EIFS	Metal Panels	Girts	Reinforced Concrete	Unreinforced Masonry <sup>(6)</sup>	Reinforced Masonry	European Block	Concrete Roofs	Metal Roofs
Controlled Perimeter or Parking and Roadways without a Controlled Perimeter <sup>(7)</sup>	Billeting and High Occupancy Family Housing	Low	I	20	79	164	207 <sup>(5)</sup>	420	151	115	26	125	30	59	20	20
	Primary Gathering Building	Low	I	20	79	164	207 <sup>(5)</sup>	420	151	115	26	125	30	59	20	20
	Inhabited Building	Very Low	I	20	66	141	187 <sup>(5)</sup>	361	108	59	20	33	20	30	20	20
Parking and Roadways within a Controlled Perimeter <sup>(7)</sup>	Billeting and High Occupancy Family Housing	Low	II	13	23	66	82 <sup>(5)</sup>	167	56	23	13	26	13	23	13	13
	Primary Gathering Building	Low	II	13	23	66	82 <sup>(5)</sup>	167	56	23	13	26	13	23	13	13
	Inhabited Building	Very Low	II	13	16	56	75 <sup>(5)</sup>	151	39	16	13	16	13	16	13	13
Trash Containers	Billeting and High Occupancy Family Housing	Low	II	13	23	66	82 <sup>(5)</sup>	167	56	23	13	26	13	23	13	13
	Primary Gathering Building	Low	II	13	23	66	82 <sup>(5)</sup>	167	56	23	13	26	13	23	13	13
	Inhabited Building	Very Low	II	13	16	56	75 <sup>(5)</sup>	151	39	16	13	16	13	16	13	13
Footnotes:																
1. For new construction, standoff distances less than those in this column are not allowed for new buildings regardless of analysis or hardening. For existing buildings that are constructed / retrofitted to provide the required level of protection, standoffs less than those in this column are allowed, but discouraged.																
2. See UFC 4-010-02, for the specific explosive weights (pounds / kg of TNT) associated with explosive weights I and II. UFC 4-010-02 is For Official Use Only (FOUO).																
3. Refer to Table 2-3 for details on the analysis assumptions and material properties for these wall types. Note that window and door construction will need to be heavier and more expensive when standoff distances are less than 82 feet (25 meters) for Explosive Weight I and 33 feet (10 meters) for Explosive Weight II. 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																
4. Metal panels and girts are not considered primary structural members. Where they are used in the same wall, use the applicable standoff that is the greatest of the two components.																
5. Non-load bearing steel studs are assumed to have slip-track connections. Closer distances may be obtained through non-standard detailing and analysis.																
6. Only used for analysis of existing structures. Not allowed for new construction.																
7. Note that standoff distances less than 43 feet (13 meters) for Explosive Weight I and 23 feet (7 meters) for Explosive Weight II will require dynamic analysis for windows because lesser distances are outside the range of ASTM F2248.																
8. Note that all of the construction included in this table must also be checked for loading conditions specified by other applicable structural criteria.																

# Standards Within UFC 04-010-01

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- **Standard 10 – Windows and Skylights**

- Windows and skylights must be designed for applicable charge weight and standoff distance.
- If controlled perimeter is more than 200 FT from building Charge Weight II can be used.
- Dynamic or Static analysis may be used to design
- Testing of window and skylight systems in accordance with ASTM F1642 with hazard ratings in accordance with ASTM F2912. Supporting structural elements tested should reflect what is being used on the subject building.



# Standards Within UFC 04-010-01

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- **Standard 10 – Windows and Skylights Continued**

- Laminated Glass Glazing systems can be designed in accordance with ASTM F2248 and ASTM E1300 in lieu of dynamic analysis or testing. This will result in a Medium LOP which is higher than required by this UFC.
- Glazing frames can be designed by dynamic analysis, in accordance with ASTM F2248 or through testing
- Glazing Frame Bite shall be in accordance with ASTM F2248
- Structural supporting elements (Jambs, Sills) can be designed statically or dynamically
- Where buildings are exempted from parking and roadway standoff requirements glazing shall be designed to minimize hazardous fragmenting (laminated system)

# Additional Items Covered In UFC 04-010-01

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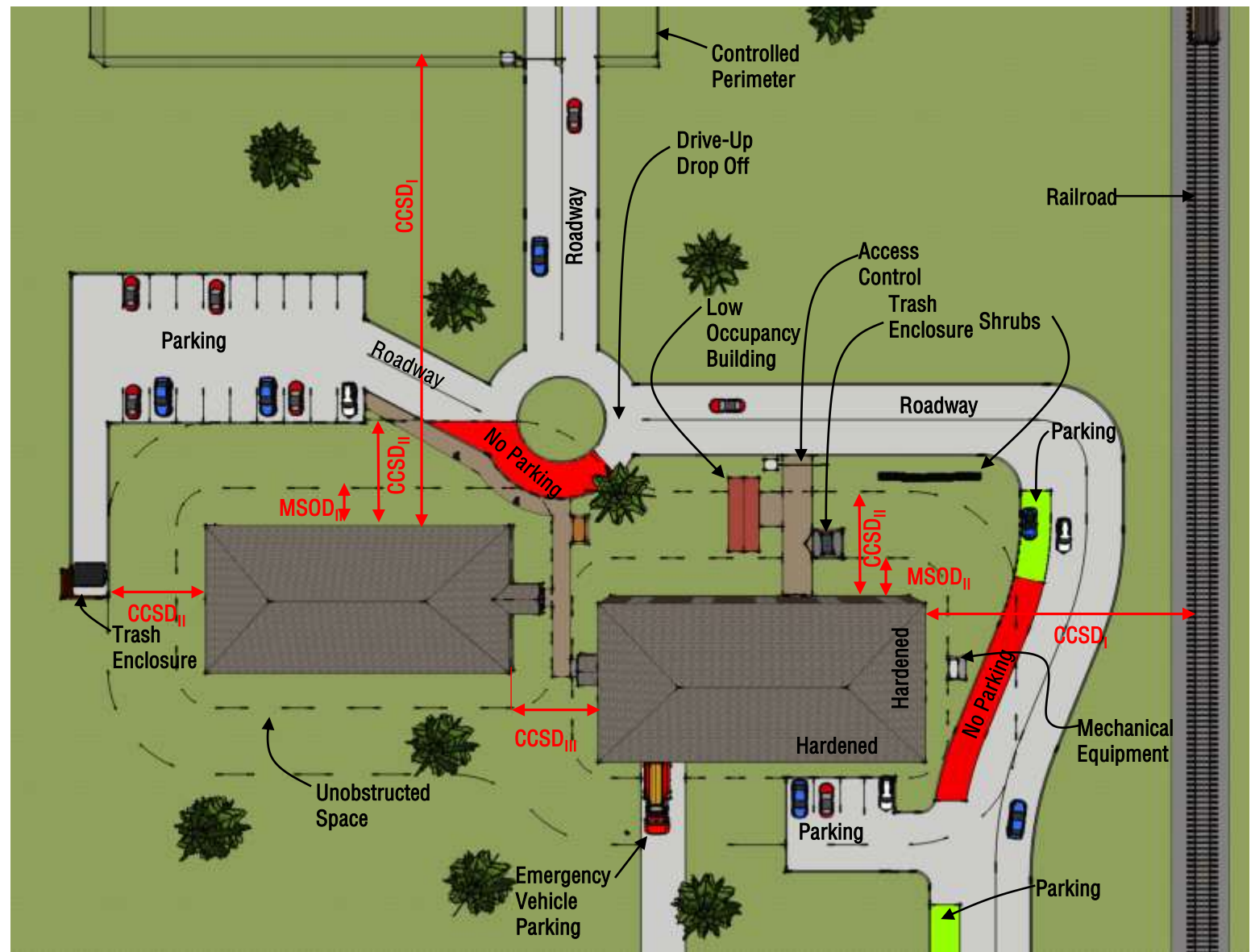
- **14 Recommendations**
  - Site Planning
  - Architectural Design
- **Expeditionary Structures**
  - Located on forward operating locations

# New Construction Examples

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- New Construction within a controlled perimeter



# **Risk Reduction Measures**

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- **Maximize Standoff Distance**
- **Prevent Building Collapse**
- **Minimize Flying Debris**
- **Provide Effective Building Layout**
- **Limit Airborne Contamination**
- **Provide Mass Notification**



# Questions?