Learning Objectives

- Learn and Understand
  - Core principles of physical security design
  - The effects of blast loading on the building envelope
  - Department of Defense Physical Security Criteria UFC 4-010-01
  - Approaches to mitigate the hazards associated with Physical Security
Today’s Presenters

• Scott L Weiland PE
  • Education
    • BSCE University of Michigan
  • Graduate Studies:
    • San Jose State University
    • Georgia Institute of Technology
  • 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
    • 21 Years in ATFP Security Engineering

Today’s Presenters

• 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: 11 Years Security Engineering
  • Expertise
    • ATPF Peer Reviews
    • Blast Design
    • Progressive Collapse
**DoD Criteria Starting Point**

- 18 Asset Categories
- 10 Aggressor Types
- 13 Tactics
- 5 Levels of Protection

**Design Criteria Development**

```plaintext
UFC 4-020-01

Asset Value $A_v \leq 0.5$

YES

NO

All aggressor likely rating $T_L \leq 0.5$

YES

NO

Risk Assessment Process

Design Criteria
```
DoD Minimum Standard Criteria

- 1 Asset Category - **People**
- 2 Aggressor Types
  - Domestic & International **Terrorists**
- 4 Tactics
  - Stationary **Bomb** - Primary
  - Hand Delivered Bomb*
  - Indirect Fire Weapon*
  - Direct Fire Weapon*
  - Airborne Contamination*
- 2 Levels of Protection

Blast Theory - Explosion

- **Shock Wave**
- **Reflected Pressure**
- **Side-On Pressure**
- **Rebound**
**Blast Theory - Distance**

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

![Graph showing the decay of incident pressure with distance]

**Source:** FEMA 427

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**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.

![Graph showing the cost of protection, including hardening, land, perimeter, and other factors]

**Source:** FEMA 427
Content Overview

• Intent of UFC 4-010-01
• Basic Concepts
  • Levels of Protection
  • Building Categories
  • Standoff Distance
• Applicability and Exemptions
• Examples
Intent of UFC 4-010-01

- 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

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
## Building Categories

- **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

- **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**
Standoff Distance – Standard 1

• What is Standoff Distance?
  • Minimum Standoff Distance – The smallest permissible standoff distance for new
collection 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

• 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

Standoff Distance – Standard 1

- **Important Site Features**
  - **Controlled perimeter** – a physical boundary at which vehicle access is controlled, generally at the perimeter of on 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

**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 (IE 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

**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

Applicability of UFC 04-010-01

- 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

- **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. I.E. using blast windows vs non-blast windows.
  - **Change of Occupancy** – I.E. 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.

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**Applicability of UFC 04-010-01**

- **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

• 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

• 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
Examples – New Buildings

• Increase Standoff Distance Wherever Possible to minimize hardening for blast loading
  • Roadway realignment to increase standoff distance to conventional construction distance

Examples – New Buildings

• Envelope Design
  • Mass is your friend (12 Ft; 600S162 16 GA Stud at 16” OC with 30 FT Standoff, CWII)

With EIFS

<table>
<thead>
<tr>
<th>( R_{0,0} )</th>
<th>Design Criteria</th>
<th>VARIOUS Secondary-NL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.95 kg</td>
<td>2.06 kg</td>
<td>Response meets</td>
</tr>
</tbody>
</table>

With Brick

<table>
<thead>
<tr>
<th>( R_{0,0} )</th>
<th>Design Criteria</th>
<th>VARIOUS Secondary-NL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.45 kg</td>
<td>2.06 kg</td>
<td>Response meets</td>
</tr>
</tbody>
</table>

To meet the blast requirements using EIFS the Studs will need to be increased to 600S162 12GA at 12” O.C. This is a significant increase in cost over the entire building.
Examples – New Buildings

• Stronger members are not always better
  • Using the same example (12 Ft; 600S162 16 GA Stud at 16" OC with 30 FT Standoff, CWII; With Brick)

<table>
<thead>
<tr>
<th></th>
<th>16GA Stud</th>
<th>12GA Stud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Reactions Based on Ultimate Flexural Resistance of Metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vu at Support A</td>
<td>2,143 lb</td>
<td>3,903 lb</td>
</tr>
<tr>
<td>Vu at Support B</td>
<td>2,143 lb</td>
<td>3,903 lb</td>
</tr>
</tbody>
</table>

The increase in stud size lead to an increase of 87% in the Equivalent Static Reaction. This leads to higher connection costs for the studs.

Examples – New Buildings

• Balanced Design Approach
  • Used to control the mode of failure
  • Glazed Opening Example
    • Window Resistance
      • Window anchorage to the supporting structural element resistance
      • Supporting structural element resistance
      • Supporting structural element anchorage to main structure resistance

  • This concept is important because when specifying window requirements, the requirements should not be in excess of what is really required as this will lead to a more expensive and unbalanced system.
  • Always review glazing submittals to ensure the window system resistance does not exceed the project requirements and if testing is submitted always review the anchorage used during testing. Often the anchorage used does not reflect project conditions.
Examples – New Buildings

• Clearly Identify the Blast Criteria in Specifications and Documents
  • Drawing Notes: Be mindful of FOOU information
    1. BUILDING CATEGORY PRIMARY ENGINEERING
    2. GLAZING, GLAZING STAMES AND ANCHORAGE
    3. STRUCTURAL ELEMENTS SUPPORTING GLAZING IN WINDOWS AND DOORS
      a. DESIGN LOADS DETERMINED IN ACCORDANCE WITH UFC 4-010-01 BASED ON
         Applicable Explosive Weight (Explosive Weight is and Actual Stand Off
         Distance)
    4. FAUCET, MALL PANELS AND POST PANELS
      a. DESIGN LOADS DETERMINED IN ACCORDANCE WITH UFC 4-010-01 BASED ON
         Applicable Explosive Weight (Explosive Weight is and Actual Stand Off
         Distance)

• Generally window, door and façade elements are specified by the architect and must be coordinated with the blast requirements by the blast consultant to avoid confusion by the vendor and costly change orders and or incorrectly designed products for the project.

Examples – Existing Buildings

• Low Cost Standoff Distance Increase
  • Existing building has parking within conventional construction standoff distance up to the minimum standoff distance.
  • Provide controlled parking at conventional construction standoff distance.
Examples – Existing Buildings

- Be Aware of Major Renovation Costs
  - Renovation projects can tend to grow in price over the course of a project. Ensure that the estimate cost does not invoke the Major Renovation Trigger.
  - Always verify the Plant Replacement Value (PRV) determined via UFC 3-701-01 with the installation. Installations may have a lower or higher PRV for the particular building under consideration.
  - Remember window replacement costs are not part of the major renovation cost trigger.
Examples – Existing Buildings

• Understand the Building Occupancy

New Inhabited Occupancy. All UFC requirements to be met.

Existing Low Occupancy. Exempt from UFC

Structural Isolation between the new and existing structure

Questions?