Antiterrorism / Force Protection
Economical Design

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Overview

• ATFP Design Criteria:
  – Who Needs to Know / Ownership
  – Intent / Applicability
  – Design Submittals
  – Conventional Construction Parameters
  – Standoff Distances
  – Windows & Doors
  – Progressive Collapse Avoidance
  – Resources
Who Needs To Know?

- Commander – Regional/Installation
- Facilities managers
  - Family Housing, Bachelor Housing (Billeting), Quality of Life support – MWR, Medical, Family Support Services, Training Facilities, Admin Facilities …
- Master Planners
  - Site constraints, encroachment, environmental requirements…
- Designers
  - PM, architect, civil, structural, electrical, mechanical, fire protection
- Physical security personnel
  - Base/Installation, Regional
Effective project planning and design effort must be coordinated with the entire design team to develop a cost effective UFC compliant solution.

- Explosive charge weight at an Installation can be increased by the Commanding Officer.
- Standoff Distance and Unobstructed Space vary with exterior wall materials and structural system.
- Controlled Parking and Access Road access control measures must be approved by Installation Security.
- Building Occupancy can now also be defined by Life Safety.

Ensure Activity and Installation Physical Security representatives are involved in the design process.
Intent of UFC 4-010-01 Standards (1-4)

• Protect DoD Personnel, not mission:
  – Provides **minimum** construction standards to mitigate terrorist threats.
  – **Minimize collateral damage** and the possibility of **mass casualties** in the event of a terrorist attack.
  – **Provide a Very Low Level of Protection** for inhabited facilities.
  – **Provide a Low Level of Protection** for Primary gathering and Billeting

• Without AT Standards Implemented
  – Mass casualties

• With AT Standards implemented:
  – Inhabited facilities: 10-25% fatalities (VLLOP)
  – Primary Gathering and Billeting: <10% fatalities (LLOP)
Levels of Protection (1-7)

• Levels of Protection (LOP) provided in the UFC meets the intent of the standards described in and establish a foundation for rapid deployment of additional measures in higher threat environments.

• These standards may be supplemented where:
  • Specific terrorist threats are identified
  • More stringent local standards apply
  • Local commanders or senior leaders dictate additional measures.
  • Unique requirements to protect assets other than personnel apply

• Verify Design Basis Threat (DBT) and required LOP for each project.
Blast Test
Charge Weight II
Blast Test – Close Up View
Charge Weight II
Very Low Level of Protection
Conventional Construction

AFTER
Very Low Level of Protection
Conventional Construction
Low Level of Protection - Conventional Construction

AFTER
Applicability (1-8)

- **New construction**
  Mandatory for all inhabited buildings regardless of funding sources as of 01 OCT 2013. Projects programmed or designed under previous editions of these standards do not have to be reprogrammed or redesigned to meet the requirements of these standards if design has proceeded beyond 35% completion or, for design-build projects, at the Request for Proposal issuance. (This is defined by ML AQ as Award of Design Build Contract).

- **Existing Buildings**
  Four triggers: Major Investment, Change of Occupancy Level, Window Replacement, and Roadway Improvement Projects. No trigger = no requirement.

- **Not for Leased Buildings**
  Required to follow security standards established by the DHS Interagency Committee (ISC) for all off-installation leased space managed by DoD and all DoD occupied space in buildings owned or operated by U.S. GSA.
Building Additions
Inhabited additions to existing inhabited buildings shall comply with the minimum standards for new buildings except that operational procedures allowed for control of parking around existing buildings in Appendix B may be applied to the building addition where conventional construction standoff distances are unavailable.

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 Appendix B.

If the building addition causes the occupancy of the building to change from inhabited to primary gathering occupancy, the entire inhabited portion of the building will be considered to be primary gathering and will trigger upgrades to the inhabited portion of the building due to change of occupancy. These triggers do not apply to leased buildings.
• Non-DoD Tenant Buildings on DoD Installations

Because buildings built by tenants on DoD installations may be taken over by DoD during their life cycles, memoranda of understanding or similar agreements between DoD components and tenants will require tenant-built buildings to comply with these standards, regardless of funding source. For the purposes of these standards, tenant-built building occupancies will be calculated assuming that building occupants are DoD personnel.
• Narratives of how each applicable standard is met.
• Applicable explosive weights and levels of protection.
• Standoff distances provided.
• Blast resistant window system and supporting structure calculations or test results.
• Building element structural analysis or design calculations where wall or roof construction is not included in Table 2-3 or if it is included in Table 2-3 and the standoff distances are less than the applicable conventional construction standoff distances.
• Progressive collapse calculations (where applicable).
### Table 2-3 Conventional Construction Parameters

<table>
<thead>
<tr>
<th>Wall or Roof Type$^{(a)}$</th>
<th>Sections</th>
<th>Span</th>
<th>Spacing</th>
<th>Support Condition</th>
<th>Supported Weight$^{(b)}$</th>
<th>Reinforcement Ratio</th>
<th>Min. Static Material Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Studs – Brick Veneer</td>
<td>2x4 &amp; 2x6 in (50x100 &amp; 50x150 mm)</td>
<td>8 – 10 ft (2.4 - 3 m)</td>
<td>16 - 24 in (400 – 600 mm)</td>
<td>S-S</td>
<td>44 psf (215 kg/m²)</td>
<td>N/A</td>
<td>875 psi (6 MPa)</td>
</tr>
<tr>
<td>Wood Studs – EIFS</td>
<td>2x4 &amp; 2x6 in (50x100 &amp; 50x150 mm)</td>
<td>8 – 10 ft (2.4 - 3 m)</td>
<td>16 - 24 in (400 – 600 mm)</td>
<td>S-S</td>
<td>10 psf (49 kg/m²)</td>
<td>N/A</td>
<td>875 psi (6 MPa)</td>
</tr>
<tr>
<td>Steel Studs – Brick Veneer$^{(c)}$</td>
<td>600S162-43 600S162-54 600S162-68</td>
<td>8 – 12 ft (2.4 - 3.7 m)</td>
<td>16 - 24 in (400 – 600 mm)</td>
<td>S-S</td>
<td>44 psf (215 kg/m²)</td>
<td>N/A</td>
<td>50,000 psi (345 MPa)</td>
</tr>
<tr>
<td>Steel Studs – EIFS$^{(c)}$</td>
<td>600S162-43 600S162-54 600S162-68</td>
<td>8 – 12 ft (2.4 - 3.7 m)</td>
<td>16 - 24 in (400 – 600 mm)</td>
<td>S-S</td>
<td>10 psf (49 kg/m²)</td>
<td>N/A</td>
<td>50,000 psi (345 MPa)</td>
</tr>
<tr>
<td>Metal Panels$^{(d)}$ (in wall or roof construction)</td>
<td>1.5 – 3 in (38 - 76 mm) 22, 20, &amp; 16 ga</td>
<td>4 – 6 ft (1.2 - 2.4 m)</td>
<td>N/A</td>
<td>S-S</td>
<td>10 psf (49 kg/m²)</td>
<td>N/A</td>
<td>33,000 psi (228 MPa)</td>
</tr>
<tr>
<td>Girts$^{(e)}$ (in wall or roof construction)</td>
<td>8Z3 &amp; 10Z3 16, 14, &amp; 12 ga</td>
<td>20 – 25 ft (6 - 7.6 m)</td>
<td>6 – 8 ft (1.8 - 2.4 m)</td>
<td>S-S</td>
<td>5 psf (24 kg/m²)</td>
<td>N/A</td>
<td>50,000 psi (345 MPa)</td>
</tr>
<tr>
<td>Reinforced Concrete$^{(f)}$</td>
<td>≥ 6 in (≥ 150 mm)</td>
<td>12 – 20 ft (3.7 - 6 m)</td>
<td>N/A</td>
<td>S-S, One way flexure</td>
<td>10 psf (49 kg/m²)</td>
<td>≥ 0.0015</td>
<td>3,000 psi (21 MPa)</td>
</tr>
<tr>
<td>Unreinforced Masonry$^{(g,h)}$</td>
<td>6 – 12 in (150 – 300 mm)</td>
<td>8 – 12 ft (2.4 - 3.7 m)</td>
<td>N/A</td>
<td>S-S, One way flexure</td>
<td>10 psf (49 kg/m²)</td>
<td>0</td>
<td>1,500 psi (10 MPa)</td>
</tr>
</tbody>
</table>

Only exterior walls that comply with table 2-3 can use standoff distances from Table B-2. Others require analysis which increases design and/or construction cost.
Clarifications to Table 2-3 Conventional Construction Parameters

<table>
<thead>
<tr>
<th>Wall or Roof Type</th>
<th>Analysis Assumptions</th>
<th>Min. Static Material Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sections</td>
<td>Span</td>
<td>Spacing</td>
</tr>
<tr>
<td>Reinforced Masonry</td>
<td>8 – 12 in (200 - 300 mm)</td>
<td>10 – 14 ft (3 – 4.3 m)  12 ft (3.7 m)  14 ft (4.3 m)</td>
</tr>
<tr>
<td>European Block</td>
<td>6 – 8 in (150 - 200 mm)</td>
<td>10 – 12 ft (3 – 3.7 m)</td>
</tr>
<tr>
<td>Concrete Roofs</td>
<td>4 – 12 in (100 - 300 mm)</td>
<td>6 ft (1.8 m)</td>
</tr>
<tr>
<td>Metal Roofs</td>
<td>K and LH joists with Metal Deck and/or 3.5 - 5.5 in (90 - 140 mm) Concrete Topping</td>
<td>30 ft (9.1 m)</td>
</tr>
</tbody>
</table>

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. /1/
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 standoff for the metal panel and the girt. /1/
7. Reinforcing steel is 60,000 psi (414 MPa) tensile strength. /1/
8. Concrete Masonry Units (excluding European block) are medium weight (120 pcf / 1922 kg/m³). /1/
9. Shear will need to be checked when using higher than minimum material strengths. /1/

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

Other roof types require analysis which increases design and/or construction cost.
Sitework Standards-Controlled Perimeter – New Construction

Figure B-1 Standoff Distances – With Controlled Perimeter

Note: CCSD = Conventional Construction Standoff Distance from Table B-1
Applicable Explosive Weights

The applicable explosive weights to be used in designing buildings required to comply with these standards are commonly established based on potential bomb locations.

- Explosive Weight I - The larger explosive weight typically required to be applied at controlled perimeters or in parking areas and on roadways where there are no controlled perimeters.

- Explosive Weight II - The smaller explosive weight typically applied in parking areas and on roadways within controlled perimeters, in trash containers, and around buildings outside unobstructed spaces.
Table B-1 Standoff Distances for New and Existing Buildings

<table>
<thead>
<tr>
<th>Distance to:</th>
<th>Building Category</th>
<th>Applicable Level of Protection</th>
<th>Conventional Construction Standoff Distance</th>
<th>Minimum Standoff Distance</th>
<th>Applicable Explosive Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Load Bearing Walls (1)</td>
<td>Non-Load Bearing Walls (1)</td>
<td></td>
</tr>
<tr>
<td>Controlled</td>
<td>Billeting and</td>
<td>Low</td>
<td>20 ft (6 m)</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Perimeter or</td>
<td>High Occupancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking and</td>
<td>Family Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roadways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled</td>
<td>Primary</td>
<td>Low</td>
<td>20 ft (6 m)</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Perimeter</td>
<td>Gathering Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking and</td>
<td>Inhabited</td>
<td>Very Low</td>
<td>20 ft (6 m)</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Roadways</td>
<td>Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled</td>
<td>Billeting and</td>
<td>Low</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Perimeter</td>
<td>High Occupancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking and</td>
<td>Family Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roadways</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>Low</td>
<td>G</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Gathering</td>
<td>Gathering Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhabited</td>
<td>Very Low</td>
<td>F</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Trash</td>
<td>Billeting and</td>
<td>Low</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Containers</td>
<td>High Occupancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>Low</td>
<td>G</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Gathering</td>
<td>Gathering Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhabited</td>
<td>Very Low</td>
<td>F</td>
<td>13 ft (4 m)</td>
<td></td>
<td>II</td>
</tr>
</tbody>
</table>

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).

Minimum Standoff Distances
MSD$_I$ = 20 feet
MSD$_{II}$ = 13 feet

MSDs were larger prior to 2012.

Design at MSD increases window costs.
Table B-2 Conventional Construction Standoff Distances

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Column Letter</th>
<th>Without Controlled Perimeter Applicable Explosive Weight</th>
<th>Within Controlled Perimeter Applicable Explosive Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Load Bearing Walls</td>
<td>Non-Load Bearing Walls</td>
</tr>
<tr>
<td></td>
<td>A PG &amp; BIL LLOP</td>
<td>B INHAB VLLLOP</td>
<td>C PG &amp; BIL LLOP</td>
</tr>
<tr>
<td>Wood Studs – Brick Veneer</td>
<td>105 ft (32 m)</td>
<td>79 ft (24 m)</td>
<td>68 ft (20 m)</td>
</tr>
<tr>
<td>Wood Studs – EIFS</td>
<td>207 ft (63 m)</td>
<td>184 ft (50 m)</td>
<td>141 ft (43 m)</td>
</tr>
<tr>
<td>Metal Studs – Brick Veneer</td>
<td>187 ft (57 m)</td>
<td>187 ft (57 m)</td>
<td>75 ft (23 m)</td>
</tr>
<tr>
<td>Metal Studs – EIFS</td>
<td>381 ft (110 m)</td>
<td>420 ft (123 m)</td>
<td>361 ft (110 m)</td>
</tr>
<tr>
<td>Metal Panels</td>
<td>n/a</td>
<td>n/a</td>
<td>56 ft (17 m)</td>
</tr>
<tr>
<td>Girts</td>
<td>n/a</td>
<td>n/a</td>
<td>23 ft (7 m)</td>
</tr>
<tr>
<td>Reinforced Concrete</td>
<td>66 ft (20 m)</td>
<td>26 ft (8 m)</td>
<td>20 ft (6 m)</td>
</tr>
<tr>
<td>Unreinforced Masonry</td>
<td>292 ft (80 m)</td>
<td>126 ft (38 m)</td>
<td>33 ft (10 m)</td>
</tr>
<tr>
<td>Reinforced Masonry</td>
<td>68 ft (20 m)</td>
<td>96 ft (28 m)</td>
<td>30 ft (9 m)</td>
</tr>
<tr>
<td>European Block</td>
<td>184 ft (50 m)</td>
<td>164 ft (49 m)</td>
<td>59 ft (18 m)</td>
</tr>
</tbody>
</table>

Column headings simplify use of CCSD table.

Standoff distance is now based on exterior construction in addition to building occupancy.

Pay attention to table footnotes for effect on cost and design.
Windows and Skylights – Design Approach

Supporting Structural Static Design
- Level of Protection
  - Very Low
  - Low
- Threat
  - Charge Weight I or II
- Standoff Distance
  - At or Beyond Wall Conventional Construction Standoff Distance

Supporting Structural Dynamic Design
- Level of Protection
  - Any Level of Protection
- Threat
  - Any Threat
- Standoff Distance
  - Any Standoff

Glazing Static Design
- Level of Protection
  - Very Low
  - Low
  - Medium
- Threat
  - Bounded by ASTM F 2248
- Standoff Distance
  - Bounded by ASTM F 2248

Glazing Dynamic Design
- Level of Protection
  - Any Level of Protection
- Threat
  - Any Threat
- Standoff Distance
  - Any Standoff
Windows and Skylights

- Glazing and frames must work as an integrated system to provide effective hazard mitigation – glass/frame/bite/anchorage/structural support.
- Provisions apply all standoff distances even if conventional wall construction standoff distances are met or exceeded.
- Minimum requirements
  - Use laminated glass or polycarbonate
  - Window frames shall be aluminum or steel. Other materials must be verified through testing.
  - Connection design of frame to building structural support system
- Supporting Structural Elements

- All glazing systems must be designed for specific design basis threat at the achievable standoff and provide required level of protection.
Noncompliant Window Performance
Glazing Hazard

Historically the glazing hazard causes up to 85% of the Injuries in blast events
Windows and Skylights - LOP

<table>
<thead>
<tr>
<th>Level of Protection</th>
<th>Potential Glazing Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below AT standards</td>
<td>Doors and windows fail catastrophically and result in lethal hazards. <em>(High hazard rating)</em></td>
</tr>
<tr>
<td>Very Low</td>
<td>Glazing will fracture, come out of the frame, and is likely to be propelled into the building, with the potential to cause serious injuries. <em>(Low hazard rating)</em> Doors will be severely deformed but will not become a flying debris hazard. <em>(Category IV)</em></td>
</tr>
<tr>
<td>Low</td>
<td>Glazing will fracture, potentially come out of the frame, but at a reduced velocity, does not present a significant injury hazard. <em>(Very low hazard rating)</em> Doors will experience non-catastrophic failure, but will have permanent deformation and will be inoperable. <em>(Category III)</em></td>
</tr>
<tr>
<td>Medium</td>
<td>Glazing will fracture, remain in the frame and result in a minimal hazard consisting of glass dust and slivers. <em>(Minimal hazard rating)</em> Doors will be operable but have permanent deformation. <em>(Category II)</em></td>
</tr>
<tr>
<td>High</td>
<td>Glazing will not fracture. <em>(No hazard rating)</em> Doors will remain intact and show no permanent deformation. <em>(Category I)</em></td>
</tr>
</tbody>
</table>

Ref: UFC 4-010-01, Table 2-1
Windows and Skylights – HAZARD LEVELS

ASTM F1642 – STANDARD TEST METHOD FOR GLAZING AND GLAZING SYSTEMS SUBJECT TO AIRBLAST LOADINGS
Windows and Skylights

TYPICAL WINDOW MAKE-UPS

SINGLE PANE

DOUBLE PANE INSULATED GLASS UNIT (IGU)
Windows and Skylights

• ASTM F 2248 Design Approach
  – Glazing
  – Frames
  – Glazing frame bite
  – Connections
  – Structural Supporting Elements
  – Guidance in PDC TR 10-02

• Dynamic Analysis of windows is required when actual standoff distance for the Explosive Weight does not fall within the limited range of ASTM F 2248
  – When standoff distance is < 43 feet for Explosive Weight I
  – When standoff distance is < 23 feet for Explosive Weight II
  – Window standoff distance is no longer maximized by CCSDs
Windows and Skylights

• Dynamic Analysis
  – Guidance in PDC TR 10-02
  – Use response limits for aluminum or steel window frame members from PDC TR 10-02
  – Use response limits for structural elements supporting window from PDC TR 06-08
  – Increased design effort over ASTM design approach often results in lower component and construction costs.
Windows and Skylights

• Testing
  – In accordance with ASTM F 1642
  – Test will include entire system including
    ❖ Glazing
    ❖ Frame
    ❖ Connections to wall
  – Loading for test must be pressures and impulses from applicable explosive weights at the actual standoff distances.
  – Windows tested must match window to be used in project.
  – Testing is cost prohibitive unless project has lots of glazing with few variations.
Compliant Window Performance
Progressive Collapse Avoidance

• Buildings 3 stories or greater required to comply with UFC 4-010-01 are required to comply with UFC 4-023-03 Design of Buildings to Resist Progressive Collapse

• Buildings with Public Access Control
  – Design limited to evaluation of exterior columns and/or walls if:
    • Electronic Access Control or Mechanical Locks on All Exterior Doors
    • Personnel to Control Visitor Access

• Buildings without Public Access Control
  – Design must include evaluation of interior columns and/or walls.
What is Progressive Collapse?
• Occupancy Categories
  – Acknowledges Multiple Occupancies and Structurally Separated Structures per IBC 1604.5.1

Table 2-2. Occupancy Categories and Design Requirements

<table>
<thead>
<tr>
<th>Occupancy Category</th>
<th>Design Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No specific requirements</td>
</tr>
<tr>
<td>II</td>
<td>Option 1: Tie Forces (TF) for the entire structure and Enhanced Local Resistance (ELR) for the corner and penultimate columns or walls at the first story. <strong>OR</strong> Option 2: Alternate Path (AP) for specified column and wall removal locations.</td>
</tr>
<tr>
<td>III</td>
<td>Alternate Path for specified column and wall removal locations and Enhanced Local Resistance (ELR) for all perimeter first story columns or walls.</td>
</tr>
<tr>
<td>IV</td>
<td>Tie Forces and Alternate Path for specified column and wall removal locations and Enhanced Local Resistance for all perimeter first story columns or walls.</td>
</tr>
</tbody>
</table>
Progressive Collapse Procedures

- **Tie Forces**, which prescribe a tensile force strength of the floor or roof system, to allow the transfer of load from the damaged portion of the structure to the undamaged portion,
- **Alternate Path method**, in which the building must bridge across a removed element, and
- **Enhanced Local Resistance**, in which the shear and flexural strength of the perimeter columns and walls are increased to provide additional protection by reducing the probability and extent of initial damage.
• Tie Force Method – Indirect Design
  – Tie Force Method Application requires structures to have 4 or more bays in span direction for 1-way load bearing structures or each direction for framed and 2-way load bearing structures.
  – Fiber Reinforced Polymers (FRP) Structural Composites must provide proof of load carrying capacity under rotation.
  – Positive mechanical anchorage required between tie force members and structural elements to prevent separation / collapse.
Tie Force Method

Floor Load:
WF = 1.2D + 0.5L

Peripheral Tie Forces of 2-Way Framed Structures:
Fp = 6 WF L1 Lp + 3 Wc
Wc= 1.2 D of cladding over length L1

Vertical Ties:
Tension design strength = largest vertical load form any story using WF
Ties need to extend continuously to first level above foundation.

NOTE: 1. Peripheral, longitudinal and transverse ties are not required in floors above crawlspaces if public access control is provided.
2. Vertical ties are not required to extend to the foundation and shall be straight. /2/
Tie Force Method

Determine effective floor load when dead loads and live loads vary.
Distribute concentrated loads over the bay.
Differences less than or equal to 25% use average load as effective WF.
Differences greater than 25% use maximum load as effective WF.
Use of Sub-Areas when effective WF varies by over 25%

(See section 3-1.3.2)
Tie Force Method

Longitudinal and Transverse Tie Forces of 2-Way Framed Structures:
\[ F_i = 3 \, W \, F \, L_1 \]

Spacing < 0.2 LT and Spacing < 0.2 LL
Tie Force Method

Figure 3-6. Splice Locations and Interruptions in Internal Tie Forces

- For internal longitudinal ties, place Type 1 mechanical splices, welded splices, and Class B lap splices in the shaded area.
- Peripheral Tie
- Anchor transverse and longitudinal ties to the peripheral ties
- For internal transverse ties, place Type 1 mechanical splices, welded splices, and Class B lap splices in the shaded area.
- For peripheral ties, place Type 1 mechanical splices, welded splices, and Class B lap splices in the shaded area

3.3-ft (1.0-m)
References and Resources
Recent UFC Security Engineering Publications

- **UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings**
  - Change 1 01 OCT 2013

- **UFC 4-010-05 Sensitive Compartmented Information Facilities Planning, Design, and Construction**
  - Change 1 01 OCT 2013

- **UFC 4-021-02 Electronic Security Systems**
  - 01 OCT 2013

- **UFC 4-022-03 Security Engineering: Fences and Gates**
  - 01 OCT 2013

- **UFC 4-023-03 Design of Buildings to Resist Progressive Collapse**
  - Change 2 01 JUN 2013
PROTECTIVE DESIGN CENTER WEBSITE

https://pdc.usace.army.mil/

Click “join” to request an account

Links to Software and Criteria
Take Aways

• ATFP Design Criteria:
  – Who Needs to Know / Ownership
  – Intent / Applicability
  – Design Submittals
  – Conventional Construction Parameters
  – Standoff Distances
  – Windows & Doors
  – Progressive Collapse Avoidance
  – Resources
Thank You!

Any Questions?

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