PHYSICAL SECURITY MEASURES

1. General Design Methodology:

1.1 General:

The proposed project is a two-story addition (20,000-sf) to the existing research facility (existing Bldg 205). By VA definition the structure is classified as a "mission critical" facility. The following blast design and physical security criteria are applicable:

Codes and Standards

VA Physical Security Design Manual – Mission Critical Facilities (2007)
VA Physical Security Design Standards Data Definitions (Restricted)
UFC 4-023-03 – Design of Buildings to Resist Progressive Collapse (14 July 2009)

Façade, Roof and Mechanical Equipment Blast Loads and Response Limits

Walls will be designed to withstand the calculated peak pressure and impulse resulting from the design level vehicle threat (W2) located at the stand-off distance, but not greater than GP2 (design level pressure), while sustaining a deformation no greater than L/30.

All façade fenestration will be designed to crack and develop post crack resistance without producing debris in response to the calculated peak pressure and impulse resulting from the design level vehicle threat (W2) located at the stand-off distance, but not greater than GP2. Windows and mullions, as well as structural backup frame systems, will be designed to resist the design level pressures while sustaining deformations no greater than L/30.

Roof structure will be designed to withstand the design level vehicle threat (W2) located at the stand-off distance, but no greater than GP2, while sustaining a deformation no greater than L/30.

Air intakes and exhausts will be designed to minimize debris in response to the maximum peak pressure and corresponding impulse of GP2. Louvered openings will be designed and detailed to restrain debris.

Mechanical penthouse façades will be designed to withstand the effects of the design level vehicle threat (W2) located at the stand-off distance, but no greater than GP2.

Explosive Threats and Damage Limits for Lobby, Delivery/Loading dock and Lobby Areas

Structural and architectural elements in loading docks, mailrooms and lobbies will be designed such that a design level satchel threat (W1) that may be delivered to those areas will not cause a level of damage beyond which progressive collapse could occur.

Elements will be designed such that building damage in these areas will be economically repairable and the space in and around damaged areas can be used and will be fully functional after cleanup and repairs.

1.2 Methods of Calculation for Façade and Roof Design:

The wall system and typical roof framing will be evaluated using single-degree-of-freedom (SDOF) analysis methods available in SBEDS (Single-Degree-of-Freedom Blast Effects Design Spreadsheets) to VA specified flexural limits.

1.3 Methods of Calculation for Glazing Design:

The design level threat will be used to evaluate demands on glazing systems. Available standoff and angle of incidence will be taken into account as determined through site and roadway orientations. Glazing response will be evaluated and glazing construction will be selected based on analysis using the analysis tool Wingard PE. All exterior glazing will be designed such that the glass cracks but debris stays in the frame. Connection loads will be specified such that connections and supporting elements develop the full interlayer (pvb membrane) resistance.

1.4 Progressive Collapse Resistance:

The tie force requirements of the latest UFC 4-023-03 will be incorporated into the design. Horizontal and vertical tie forces based on dead and live loads and bay spacing will be calculated and continuous reinforcing steel designed and provided for floors and columns to satisfy these requirements. At the roof level, straps will supplement joist and deck elements to provide required tie force levels and distribution.

Enhanced local resistance of corner and penultimate columns will be provided as required by the UFC 4-023-03. For life-safety design, column shear capacity (section and connection shear) will be required such that full flexural capacity can be developed in those columns. Primary structural elements in lobby, dock and mailroom areas will be protected against the satchel charge threat (W1). Protection will consist of standoff sections of frangible material to a minimum height of 6'-0" or column encasement such that column shear failure or breach does not occur.

1.5 Other:

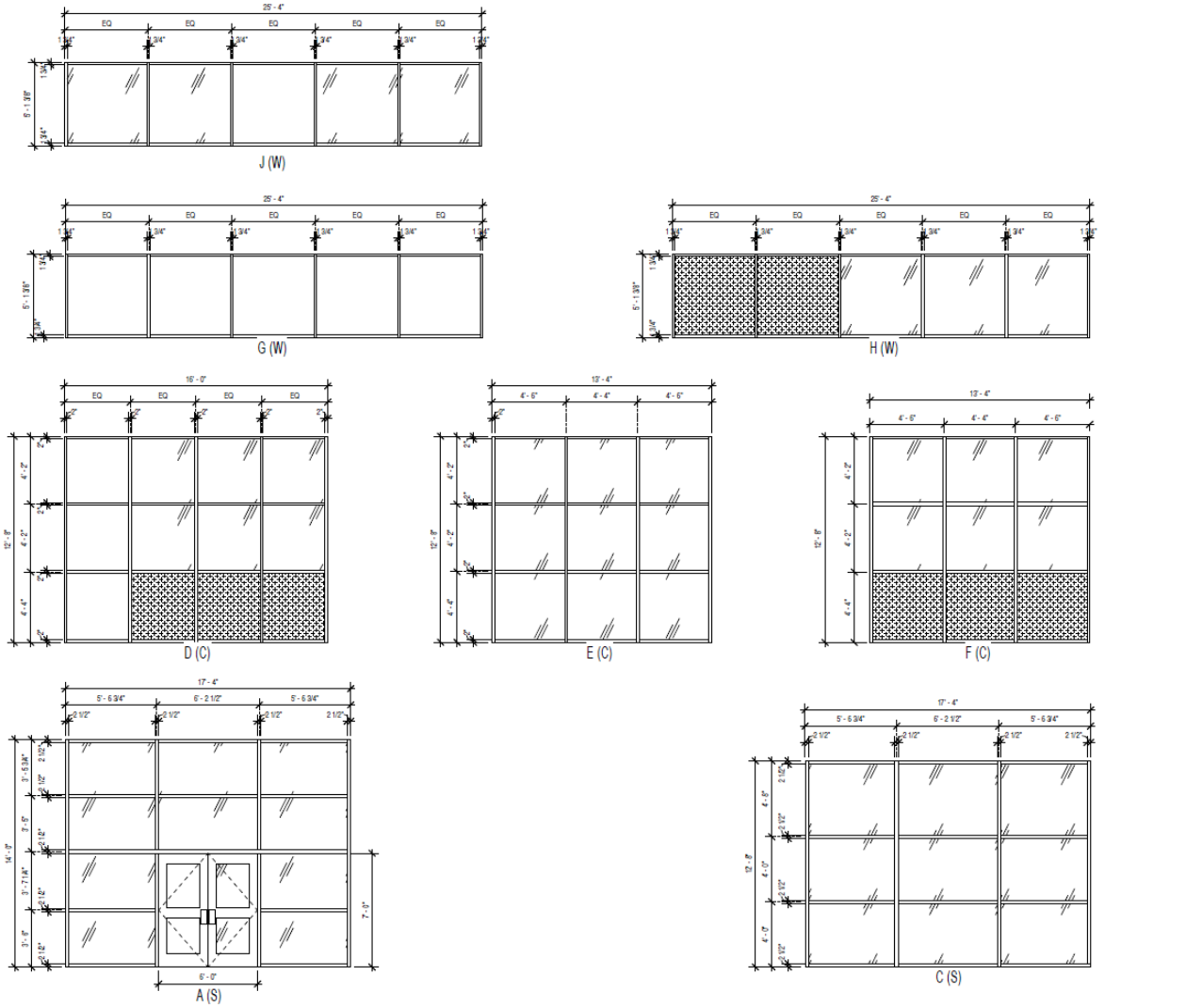
Perimeter Fences: Not applicable
Gates: Not applicable
Vehicle Barriers: Not applicable
Parking and Roadways: Minimum standoff permitted is 50-ft

2. Design Requirements:

2.1 Glazing:

- The glazing layup for the exterior windows, curtain walls and storefronts will consist of IGU systems with interior laminated glass as specified in the table below (minimum).

Window or Curtain Wall	Elevation	Required bite (min)	Laminated IGU
A, C	South	0.75 in	1/4 AN + ½ Air + (5/32 AN + 0.060 PVB + 5/32 AN)
D, E, F	North	0.75 in	1/4 AN + ½ Air + (1/8 AN + 0.060 PVB + 1/8 AN)
G, H, J	East and South	0.75 in	1/4 AN + ½ Air + (1/8 AN + 0.060 PVB + 1/8 AN)



WINDOWS (W), STOREFRONTS (S), CURTAIN WALLS (C), & LOUVERS (L)

95% Design Submittal

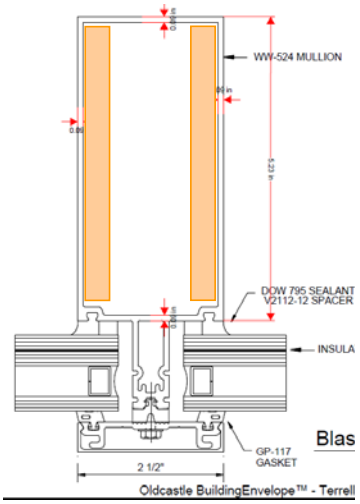
- The table above shows minimum required thickness and glass type to satisfy the requirements in Section 1.1. If thicker or stronger type glass is used, bite requirements and connection loads for aluminum frame (for non-spanning head/sill/jamb frame members connected to supporting structure along their length) must be recalculated.

2.2 Window and Curtain Wall Mullions:

- Window and curtain wall systems must meet the following minimum requirements:

Storefront A – South (1st floor)

- Use BlastMax™ – Blast resistance Curtain Wall 2½"x7½" system
- Use two (2) 4¾"x½" A36 steel inserts for interior vertical mullions continuous along the full span of the mullion. No inserts are required for vertical jambs or horizontal members.
- Top and bottom connections for reinforced vertical mullions (to H-frame head and floor slab, respectively) must be designed for 8 kips for inbound and rebound direction.
- Jamb members must be connected along their length to vertical members of H-frame with a connection design load of 420 lb/ft.



Curtain wall C – South (2nd floor)

- Use BlastMax™ – Blast resistance Curtain Wall 2½"x7½" system
- Use two (2) 4¾"x3/8" A36 steel inserts for interior vertical mullions continuous along the full span of the mullion. No inserts are required for vertical jambs or horizontal members.
- Top and bottom connections for reinforced vertical mullions (to H-frame head and floor slab, respectively) must be designed for 8 kips for inbound and rebound direction.
- Jamb members must be connected along their length to vertical members of H-frame with a connection design load of 662 lb/ft.

Curtain walls D, E and F – North

- Use BlastMax™ – Blast resistance Curtain Wall 2½"x7½" system
- Use two (2) 4¾"x½" A36 steel inserts for interior vertical mullions continuous along the full span of the mullion. No inserts are required for vertical jambs or horizontal members.
- Top and bottom connections for reinforced vertical mullions (to H-frame head and sill or floor slab, respectively) must be designed for 8 kips for inbound and rebound directions.
- Jamb members must be connected along their length to vertical members of H-frame with a connection design load of 974 lb/ft.

Windows G, H and J – East and South

- Use BlastMax™ – Blast resistance Window Wall BRW-500 system with two (2) 2¼"x¼" A36 steel inserts for vertical frame members (mullions and jambs). Alternatively, use BlastMax™ – Blast resistance Curtain Wall 2½"x7½" system without steel inserts.
- Top and bottom connections for mullions and jambs (to H-frame head and sill members, respectively) must be designed for 6 kips for inbound and rebound direction (for either of the two window frame system options specified above).
- Head and sill members must be connected along their length to supporting H-frame with a connection design load of 1035 lb/ft.

- Steel inserts are connected to vertical mullions as a stacked (non-composite) system. Minimum connections must be designed to ensure that the insert and mullion deflect together but minimizing composite action between the steel inserts and the mullions.

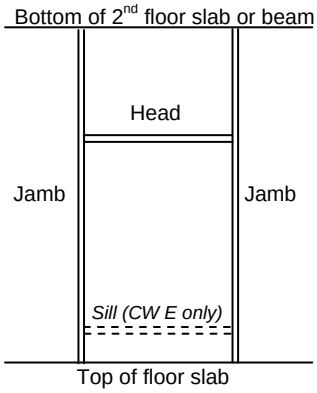
- Connections of horizontal members to vertical members must be designed to develop the full flexural dynamic strength (including dynamic increase factors) of the horizontal members.

- The specifications for the window frame systems shown above represent minimum requirements to satisfy the criteria in Section 1.1. If heavier/stronger members are used, connection loads for mullions must be increased considering the ultimate flexural strength of the members.

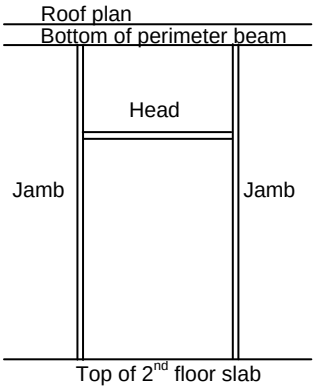
- Connection design loads must be treated as factored loads for LRFD design. Connections must be designed using the appropriate LRFD design methods and including the appropriate safety factors (ϕ).

2.3 H-frames for window and curtain walls

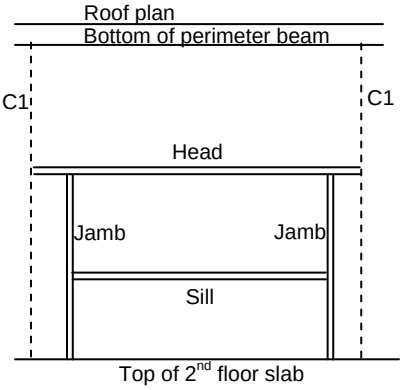
- Window and curtain wall systems must be supported by H-frames as specified below.



Storefront A – South
Curtain Wall E – North



Curtain Wall C – South
Curtain Walls D, F – North



Windows G, H, J – South and East

Window or Curtain Wall	Jamb		Head		Sill	
	Member *	Connection Load (kips)	Member	Connection Load (kips)	Member	Connection Load (kips)
A	HSS 8x2x1/4	11.2	HSS 8x2x1/4	11.2	n/a	n/a
C	HSS 8x2x1/4	13	HSS 8x2x1/4	11.2	n/a	n/a
D	HSS 8x3x1/2	27	HSS 8x3x1/2	25	n/a	n/a
E	HSS 8x3x3/8	22	HSS 8x3x3/8	24	HSS 8x3x3/8	24
F	HSS 8x3x3/8	22	HSS 8x3x3/8	24	n/a	n/a
G, H, J	HSS 8x2x1/4	28	HSS 16x8x5/16 **	29	HSS 8x2x1/4	10

* All HSS members are A500 Gr. B (Fy = 46 ksi)
** Header for windows G,H,J is oriented with long (16") side vertical and it spans between RC columns

- Connection of H-frame members (horizontal to vertical members and vertical members to supporting structure) must be designed as "simple" (shear) connections, per AISC-B3.6a (minimizing rotational restraint), for the design loads specified in the table above. Connections must have sufficient inelastic rotation capacity to accommodate a minimum of 4 degrees rotation.

- Connection design loads must be treated as factored loads for LRFD design. Connections must be designed using the appropriate LRFD design methods and including the appropriate safety factors (ϕ). Specified connection design loads are for inbound and rebound directions.

- The H-frame member sizes shown above represent minimum requirements to satisfy the criteria in Section 1.1. If heavier/stronger members are used, connection loads must be increased considering the ultimate dynamic flexural strength (including dynamic increase factors) of the members.

2.4 Exterior Reinforced Masonry Walls

2.4.1 Typical Exterior Wall (no openings)

- All typical exterior 8-inch masonry walls shall be reinforced with #5 @ 48" o.c. vertical reinforcement, as specified in the 95% Structural Drawings.

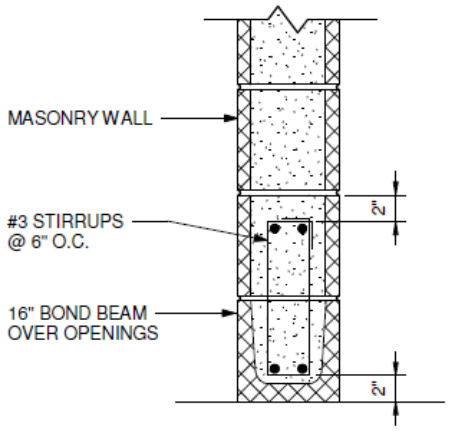
- Exterior masonry walls must be connected at top and bottom (to concrete floor slab and bottom of second floor concrete beam for first story wall, and to top of second floor concrete beam and roof perimeter steel beam, for second floor wall, respectively) with a connection design load of 460 lb/ft for inbound and rebound direction.

- Bottom connections shall be provided with dowels (shear friction) with full development length or steel angles and concrete anchors into masonry wall (grouted cells) and concrete slab.

- Top connections shall be provided by steel angles with concrete anchors into the masonry wall (grouted cells) and anchored or welded to the bottom of the 2nd floor concrete beam (first floor wall) or roof beam (2nd floor wall), respectively.

2.4.2 Lintel, Sill and Jamb Reinforcement (at curtain walls)

- All lintels must be 16" bond beams with (2)#6 top and bottom (minimum), as specified in the 95% Structural Drawings (see below).



- All sills must be 16" bond beams with (2)#6 top and bottom (minimum), same as the lintels (see above).

- All jambs (at end of lintel and sill bond beams) must be two-cell reinforced with (2)#6 at each face (same as lintel and sill bond beams).

- Lintel and sill bond beams reinforcement must be continuous over the span of the opening and extended over the jamb reinforced cells.

2.4.3 Wall above and below ribbon windows (G/H/J)

- Wall above and below ribbon windows G, H, and J, span vertically between roof perimeter beam and H-frame header, and between H-frame sill and concrete floor slab, respectively. Wall must be reinforced with #4 @ 48" o.c. vertical reinforcement.

- Wall above and below ribbon window must be connected at top and bottom (to roof perimeter beam and H-frame header, and to H-frame sill and concrete floor slab, respectively) with a connection design load of 1200 lb/ft for inbound and rebound direction.

2.4.4 Generator

- All exterior masonry walls at generator must be reinforced with #5@48" o.c. (1 out of every 6 cells) vertical and horizontal (bond beam) reinforcement. All reinforced cells must be grouted.

- Dowels into foundation and splices with full development length must be provided for vertical reinforcement. Horizontal reinforcement must be continuous over the full width of the wall (with full tension development length splices, if required).

2.4.5 General

- Reinforcement for exterior masonry walls and bond beams (lintel, sill and jambs) must be continuous over the span of the wall. Splices must be placed away from the maximum moment regions (away from mid-span) and must be detailed for full tension development length considering dynamic increase factors for the strength of steel reinforcement and concrete.

- Connection design loads must be treated as factored loads for LRFD design. Connections must be designed using the appropriate LRFD design methods and including the appropriate safety factors (ϕ).

- Where additional vertical reinforcement is provided, top and bottom typical connection design load (460 lb/ft) must be increased by the ratio of the actual area of steel reinforcement to the typical steel reinforcement area (#5@48" o.c. = 0.078 in^2/ft).

2.5 Roof

- Roof metal deck must be 1-1/2" x 20 Ga. (minimum)

- Roof beams and joist must be as specified in the 95% Structural Drawings, with the following additional recommendations:

    - All 14K1 joists (as shown in the 95% Structural Drawings – drawing SS2.4) must be replaced with 14K6 joists.
    - All 18LHSP pitched joists must be equivalent or better (stronger) than 18LH02 joists.

- All support connections of roof joists and beams must be designed to develop the full flexural strength (maximum capacity) of the members.

- All roof perimeter beams must be designed to resist the horizontal reaction loads (connection design loads) from reinforced masonry walls and H-frame members connected to the perimeter beams. Analysis of the roof perimeter beams must demonstrate that the beams can accept the reaction loads from the walls and H-frame members, acting in the direction of the weak axis of the perimeter beams, without compromising its capacity. Alternatively, kickers or bracing members can be provided to transfer the horizontal reaction loads into the roof diaphragm.

2.6 Columns at receiving areas

- Reinforced concrete columns C1 at the loading dock, lobby and mailroom areas must be as specified in the 95% structural drawings SS5.2 (minimum).

- A 3-ft standoff against satchel charges must be provided through sections of frangible materials at reinforced concrete columns at receiving areas (loading dock, lobby and mailroom) up to a minimum height of 6-ft.