Jefferson Barracks Building 29

ATFP

Historic

Seismic

Progressive Collapse
Jefferson Barracks
Building 29

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AIA Learning Objectives

• Describe the historic significance and features of the Jefferson Barracks Building 29 structure.
• Identify the seismic deficiencies of the structure.
• Explain how progressive collapse and ATFP requirements complicated the design.
• Discuss the design solutions used to mitigate these issues.
• Identify additional challenges discovered during construction.
Historic

• Old
• Historic
Historic

Constructed in 1898 as Cavalry Barracks

Renovate to modern standards
Historic

Character Defining Features

Stately            Ventilators            Porches            Arches            District
Historic

• 3 and 4 wythe brick
• Massive construction
• Majestic
Historic

- Limestone watertable
- Limestone foundation walls
- Arched windows
- Chimneys
- Pilasters
Historic

- Cast-iron columns
  - Weak in shear and tension
  - Good in compression
Historic

- Arched windows
- Custom blast connection at top for ATFP windows
Anti-Terrorism Force-Protection
ATFP - Intent

• UFC 04-010-01: “MINIMIZE MASS CASUALTIES” stated 11 times
• Protection against all potential threats is cost prohibitive.
ATFP – Occupancy Triggers

High Occupancy Family Housing

≥ 13 Family?

Family?

≥ 11 routine DoD personnel?

> 1/430 sf?

≥ 50 routine DoD personnel?

Primary gathering

Low Occupancy Family Housing

Low Occupancy Family Housing ATFP Exempt

Billeting

Inhabited

≥ 50 routine DoD personnel? NO

≥ 13 Family? YES

Family? YES

Sleeping space?

≥ 50 routine DoD personnel? NO

> 1/430 sf? YES

High Occupancy Family Housing

Low Occupancy Family Housing ATFP Exempt

Billeting

Inhabited
ATFP – Occupancy, B29

≥ 13 Family? → YES

Family? → YES

Sleeping space? → YES

256 ≥ 11 routine DoD personnel → NO

Low Occupancy ATFP Exempt

88 SF per person > 1/430 SF → NO

YES

256 ≥ 50 routine DoD personnel

Primary gathering → YES

Inhabited

High Occupancy Family Housing

Low Occupancy Family Housing ATFP Exempt Exempt

Billeting
ATFP – Project Triggers

ATFP required on addition

Addition <50% final sf?

Primary Gathering Occupancy?

Addition?

Remodel?

Project cost >50% plant replacement cost?

Window replacement project?

Building reinforcement at replaced windows does not trigger ATFP for whole building

DoD occupancy < 25% total sf, Enhanced Lease, Town Center, Fisher House or Low occupancy?

No ATFP required

ATFP required on existing AND addition

ATFP required

YES

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES

NO

YES
**ATFP – Project Triggers**

- **ATFP required on addition:**
  - Addition <50% final sf?
    - NO → Go back
    - YES → ATFP required on existing AND addition
  - Primary Gathering Occupancy?
    - NO → Addition?
    - YES → ATFP required
  - Remodel?
    - NO → Project cost >50% plant replacement cost?
      - NO → ATFP required
      - YES → Building reinforcement at replaced windows does not trigger ATFP for whole building
    - YES → No ATFP required

- **DoD occupancy < 25% total sf, Enhanced Lease, Town Center, Fisher House or Low occupancy?**
  - NO → Window replacement project?
    - NO → No ATFP required
    - YES → Yes

- **Addition?**
  - NO → Remodel?
    - NO → Project cost >50% plant replacement cost?
      - NO → ATFP required
      - YES → Building reinforcement at replaced windows does not trigger ATFP for whole building
    - YES → No ATFP required
  - YES → All new?
    - NO → Remodel?
      - NO → Project cost >50% plant replacement cost?
        - NO → ATFP required
        - YES → Building reinforcement at replaced windows does not trigger ATFP for whole building
      - YES → No ATFP required
    - YES → Yes

- **Project cost >50% plant replacement cost?**
  - NO → ATFP required
  - YES → Building reinforcement at replaced windows does not trigger ATFP for whole building
ATFP – Project Triggers

1. Addition <50% final sf?
   - No
   - Yes
     - ATFP required on existing AND addition

2. Primary Gathering Occupancy?
   - Yes
   - No
     - Go back 3 spaces

3. Addition?
   - Yes
   - No
     - Remodel?
       - Yes
       - Project cost >50% plant replacement cost?
         - Yes
         - ATFP required
         - No
         - Yes
       - No
         - ATFP required

4. Remodel?
   - Yes
   - No
     - Window replacement project?
       - Yes
       - Building reinforcement at replaced windows does not trigger ATFP for whole building
       - No
       - No

5. DoD occupancy < 25% total sf, Enhanced Lease, Town Center, Fisher House or Low occupancy?
   - Yes
   - No
     - No ATFP required
ATFP – Project Triggers, B29

DoD occupancy < 25% total sf, Enhanced Lease, Town Center, Fisher House or Low occupancy?

NO

Remodel?

YES

Project cost >50% plant replacement cost?

NO

ATFP required on addition

Addition <50% final sf?

NO

Primary Gathering Occupancy?

YES

ATFP required on existing AND addition

YES

Go back 3 spaces

NO

Addition?

NO

All new?

YES

Building reinforcement at replaced windows does not trigger ATFP for whole building

YES

Window replacement project?

NO

No ATFP required

YES

ATFP required
ATFP - Triggers

• Three stories in front, four on back; progressive collapse required

• What is a story?
  – Human occupancy
    • Egress
    • Lights
    • Ventilation
Seismic
Seismic - Analysis of Existing Structures

• UFC 3-310-04 Seismic Engineering
  – Seismic Design Category C 50% trigger
  – Seismic Design Category D 30% trigger
  – Trigger invokes RP8

• RP8 directs to ASCE 41

• ASCE41-13
  – Reduced earthquake & Analyze, modify, analyze, modify...
  – Collapse Prevention
Retrofit
Retrofit - Endoskeleton
Retrofit - Endoskeleton

- Blast Load

Progressive Collapse
- Hole in wall
- Eliminate 1 column
Retrofit - Endoskeleton

- Blast Load

Progressive Collapse
- Hole in wall
- Eliminate 1 column
Retrofit - Endoskeleton

- Loads: Wind, Blast, Seismic
Retrofit - Endoskeleton

- Floors load braces
- Braces load foundation
Retrofit - Spreader Beams
Retrofit - Foundation

- FIRST FLOOR
- BASEMENT FLOOR
- MAT SLAB
- REINFORCED CONCRETE FOUNDATION SISTER WALLS
REINFORCED CONCRETE FOUNDATION SISTER WALLS
Retrofit - Foundation

HEAVY
MAT
SLAB
Retrofit - Brick Ties

NOTE:
RODS TO BE CENTERED IN BRICK VERTICALLY AND IN THE CENTER 1/3 HORIZONTALLY

DRILL AND EPOXY 3/8" DIA. THREADED RODS AT 32"O.C. HORIZONTALLY (U.N.O.)
Retrofit - Lever Beams
Retrofit - Lever Beams

PROVIDE STIFFENER PLATE BOTH SIDES OF BEAM WEB

WF LEVER BEAM

FACE PLATE EACH SIDE OF BEAM

3/8 TYP
Retrofit - ATFP Windows

- 33 ft standoff
- Moderate blast load
- Massive walls
- Brittle walls
- Reinforcing required, but light reinforcing ok
Retrofit - Wall Ties
Retrofit - Wall Ties

EXISTING BRICK WALL
Retrofit - Roof Trusses

- Tension only rods
- Friction connections
- Unbraced top chord
Retrofit - Roof Trusses
Construction Challenges
Construction - Interesting Header
Construction - Chimneys
Construction - Cast Iron Columns
Construction - Cast Iron Columns

EXISTING CAST-IRON COLUMN

EXISTING CAST-IRON COLUMN CAP

EXISTING CAST-IRON COLUMN

EXISTING CAST-IRON COLUMN

EXISTING CAST-IRON COLUMN

NEW STEEL COLUMN CAP

EXISTING CAST-IRON COLUMN
THANK YOU