Jefferson Barracks Building 29

ATFP

Historic

Seismic

Progressive Collapse
AIA Learning Objectives

• Describe the preservation efforts used to maintain the historic significance and features of the Jefferson Barracks Building 29 structure.

• Identify the seismic deficiencies of the structure and their safety implications.

• Explain how progressive collapse and ATFP requirements complicated the preservation efforts.

• Discuss the design solutions used to mitigate the structure’s safety issues.
Historic

Constructed in 1898 as Cavalry Barracks

Renovate to modern standards
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**

- **≥13 Family?**
  - YES: High Occupancy Family Housing
  - NO: Billeting

- **Family?**
  - YES: Sleeping space?
  - NO: Low Occupancy Family Housing ATFP Exempt Exempt

- **Sleeping space?**
  - YES: ≥11 routine DoD personnel?
  - NO: Low Occupancy ATFP Exempt

- **≥11 routine DoD personnel?**
  - YES: ≥50 routine DoD personnel?
  - NO: Inhabited

- **≥50 routine DoD personnel?**
  - YES: Primary gathering
  - NO: Inhabited

- **Primary gathering**
  - YES: >1/430 sf?
  - NO: Inhabited

- **>1/430 sf?**
  - YES: Inhabited
  - NO: Inhabited
ATFP – Occupancy, B29

≥ 13 Family? → YES

Family? → YES

Family? → NO

Billeting → YES

High Occupancy Family Housing

Low Occupancy Family Housing ATFP Exempt

Sleeping space? → YES

107 ≥ 11 routine DoD personnel

107 ≥ 50 routine DoD personnel

215 SF per person > 1/430 SF

Primary gathering → YES

Inhabited

Low Occupancy ATFP Exempt

NO
ATFP – Project Triggers

ATFP required on addition

Addition <50% final sf?

Yes

NO

ATFP required on existing AND addition

Primary Gathering Occupancy?

YES

NO

Remodel?

Addition?

NO

YES

Project cost >50% plant replacement cost?

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

Window replacement project?

Yes

NO

No ATFP required

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

Yes

NO

ATFP required
ATFP – Project Triggers

ATFP required on addition

Addition <50% final sf?

No

Yes

ATFP required on existing AND addition

Primary Gathering Occupancy?

Yes

Addition?

No

Remodel?

Yes

Project cost >50% plant replacement cost?

No

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

Yes

No ATFP required

Window replacement project?

No

YES

NO

YES

NO
ATFP – Project Triggers

Addition <50% final sf?
- NO
- YES
  - Go back 3 spaces
  - ATFP required on existing AND addition
  - ATFP required on addition

Primary Gathering Occupancy?
- YES
- NO
  - Addition?

Addition?
- YES
- NO
  - Remodel?

Remodel?
- YES
- NO
  - Project cost >50% plant replacement cost?

Project cost >50% plant replacement cost?
- YES
- NO
  - ATFP required

Window replacement project?
- YES
- NO
  - 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?
- Yes
- NO
  - No ATFP required
ATFP – Project Triggers, B29

ATFP required on addition

Addition <50% final sf?

NO

DO

ATFP required on existing AND addition

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

YES

NO

Remodel?

YES

Project cost >50% plant replacement cost?

NO

YES

ATFP required

NO

Window replacement project?

YES

NO

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

NO
ATFP - Triggers

• Three stories in front, four in 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
Retrofit - Endoskeleton

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

- **First Floor**
- **Reinforced Concrete Foundation Sister Walls**
- **Basement Floor Mat Slab**
- **1" Void Form**
- **Existing Rubble Foundation**
REINFORCED CONCRETE FOUNDATION SISTER WALLS
Retrofit - Foundation

HEAVY MAT SLAB
Retrofit - Brick Ties

EXISTING MULTI-WYTHE BRICK WALL

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
- Walls
  - Massive
  - Brittle
- Reinforcing required
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 - Chimneys
Construction - Cast Iron Columns
Construction - Cast Iron Columns
THANK YOU