



**RDECOM**

*Presented to:*  
**National Defense Industrial Association**  
**52<sup>nd</sup> Annual Fuze Conference**

**FUZE SURVIVABILITY & MOUT  
TESTING AT AMRDEC/RTTC  
ROCKET-ON-A-ROPE (ROAR)  
TEST FACILITY**



*Approved for public release; distribution unlimited.  
Review completed by the AMRDEC Public Affairs Office (6 May 2008; FN3550).*

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

**MAY 2008**

*Presented by:*  
**Donald E. Limbaugh, Dynetics**  
**Milton E. "Gene" Henderson, Jr., AMRDEC**

- **MOUT Target Testing**

- What is MOUT
- MOUT Target Descriptions
  - Brick Over Block Walls (BoB)
  - Double Reinforced Concrete Walls (DRC)
  - Triple Width Brick Walls (TB)
  - Earth and Timber Bunker
  - Other Targets
- MOUT Target Testing
  - Airgun
  - Sled Testing
  - ROAR

- **ROAR Testing**

- ROAR Test Method
- ROAR Capabilities
- ROAR for SMF Testing

- **SMF Testing**

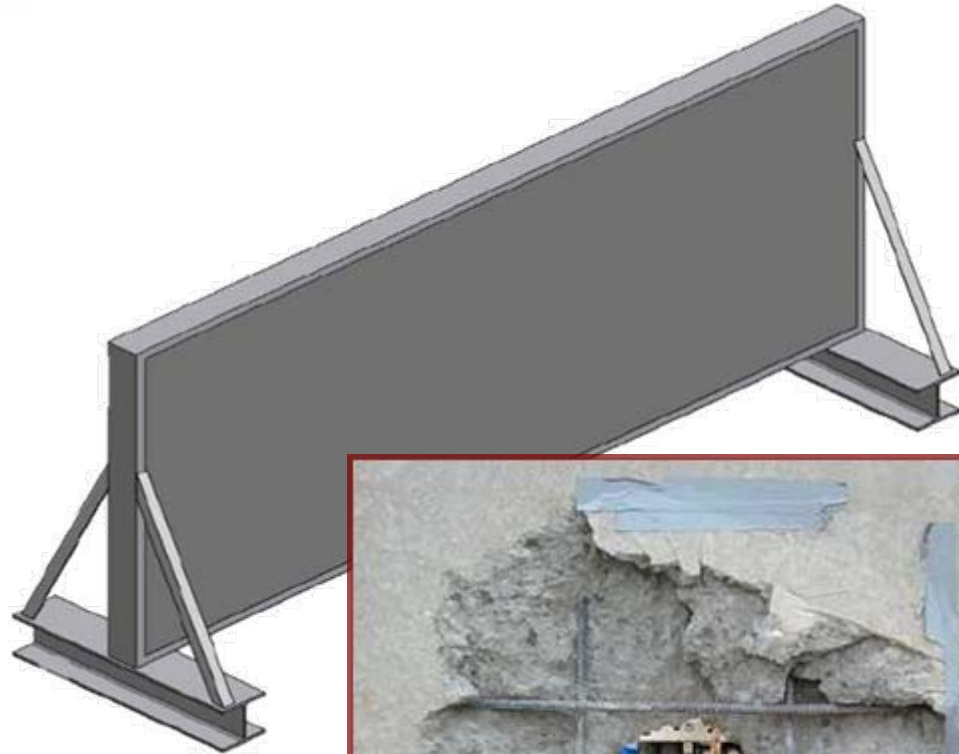
- What is SMF?
- SMF Testing To-Date

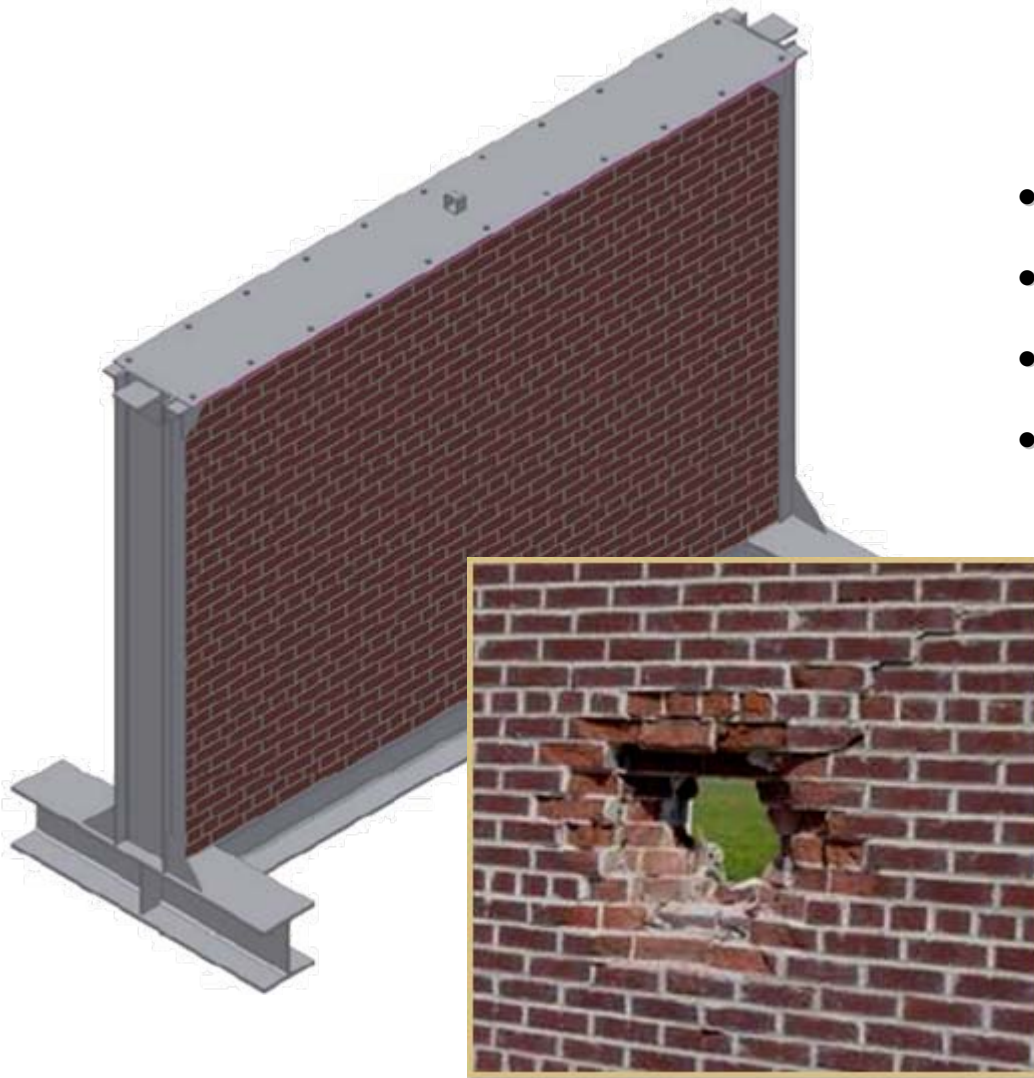
- **What is MOUT?**
  - MOUT is Military Operations in Urban Terrain
- **MOUT targets became important as warfare became increasingly Urban**
  - Define what targets are most likely to be encountered on today's battle field within urban terrain
  - Define a standard for testing targets that are “representative” of what would be found in the urban battlefield
- **What specifies the Target Definitions**
  - Technical Manual 30-78 – Interim Standards for the Construction of MOBA Structures for Weapons Effects Tests
    - Published by the U.S. Army Human Engineering Laboratory in December 1978
    - Covers limited number of walls and earth and timber bunkers
  - NATO STANAG 4536 – Representative Building Targets, Unfortified and Fortified
    - May 2004
    - Covers walls as well as ceilings and floors, to include the entire floor plan of test structures



- **12 Inch Brick and Concrete Masonry Unit (CMU) Target**
- **Built in a freestanding steel frame**
- **Typically 8 X 12 ft.**
- **Uses Brick Pavers and 8-inch CMU**
  - **Brick Pavers**
    - Class SX, Type 1, Application PX
    - Minimum compressive strength of 12.5-ksi
  - **CMU**
    - 8-inch, 30-lbs two cell unit
    - Compressive strength is 1.5-ksi
  - **Mortar**
    - Type M masonry cement
    - Compressive strength of 2.5-ksi

- **8 Inch Double Reinforced Concrete Wall**
- **Built in a freestanding steel frame**
- **Typically 8 X 17.5 ft**
- **Uses 3.5-ksi concrete and #4 reinforcing bar (13-mm)**
- **Reinforcing bar is placed 1-inch from each surface and spaced 1-ft on centers**

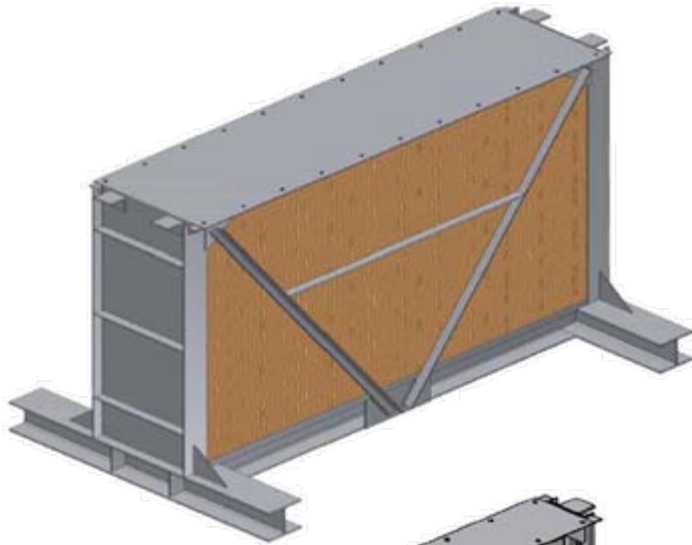




- **12 Inch Triple Brick Wall**
- **Built in a freestanding steel frame**
- **Typically 8 X 12 ft.**
- **Uses Brick Pavers and Mortar**
  - **Brick Pavers**
    - Class SX, Type 1, Application PX
    - Minimum Compressive Strength of 12.5-ksi
  - **Mortar**
    - Type M masonry cement
    - Compressive Strength of 2.5-ksi

- **Timber structure placed in a hole with a perimeter of sandbags**
- **From ground level the bunker measures 8' 7" long, 11' 7" wide, and 5' high**
- **Bunker has a forward firing aperture and a rear door**





- **Adobe walls**

- **Single Adobe**

- 17-inch thick

- Uses Adobe Bricks

- Low Compressive Strength

- **Double Adobe**

- 34-inch thick

- Uses Adobe Bricks

- Low Compressive Strength

- **8-Inch Block Wall**

- Wall constructed of CMUs with a steel frame around them

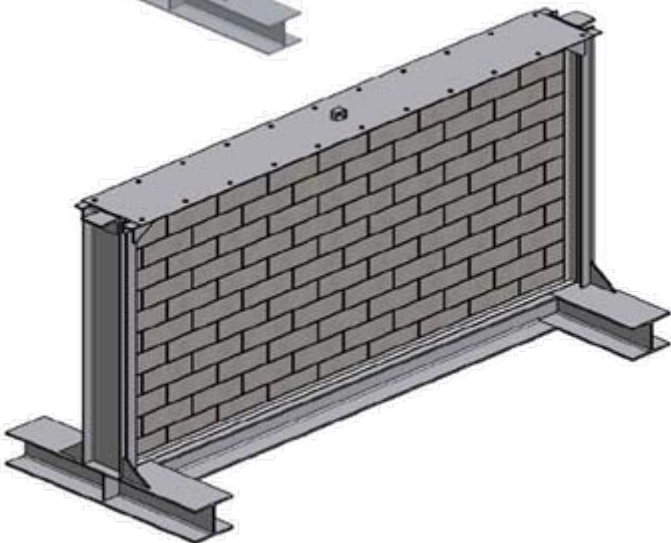
- Weak target

- **6-Inch Filled Block Wall**

- Uses 6-inch CMU blocks and then backfills wall with sand

- **Double Brick Wall**

- Two Brick faces with a 60-mm hollow core





# ROAR TESTING

## ROCKET-ON-A-ROPE

Utilizes a 2.75-inch NDI rocket motor to propel a test article at supersonic speeds along dual high tensioned ropes for accurate hit point and missile orientation

- Developed by PS-WF/Dynetics in 2003 originally intended for the minimum range impact testing of the Compact Kinetic Energy Missile (CKEM) program
- Low Cost Per Test (\$8-10 K basic test) and short turnaround time
- High-Fidelity Testing due to low axial launch accelerations and minimal lateral accelerations as compared to both Air Gun and Sled Testing. Minimal mounting hardware (<10 percent mass)
- Conducted 30+ successful tests for various programs including Hydra 70 M255 flechette, Survivable Modular Fuze (SMF), APKWS Fuze, and MSIC foreign weapon system
- Completed a 4-rope design with ~100 lb payload to prove capability for warhead and fuze integration testing in 2008 (NLOS-LS PAM)
- Possible Far-Term Testing includes KEAPS round against KE Rod, PS-WF Hybrid KE System

Heat resistant silicon-coated fiberglass sleeving used to shield ropes from the rocket plume



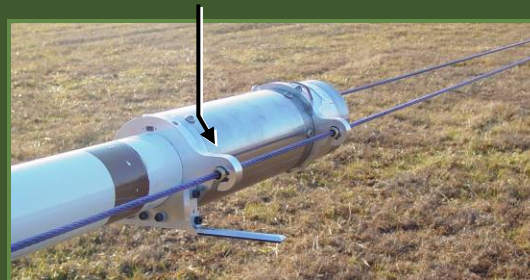
Dual ¼" diameter high strength 12-Strand ropes tensioned to 2000-4000 lbs extend from launch point to target location



SROAR tower and electric winches provide mobility of testing, elevated launch point and precise tension control



Aluminum fixtures on front and aft of test article house trumpeted brass inserts that ride on the ropes



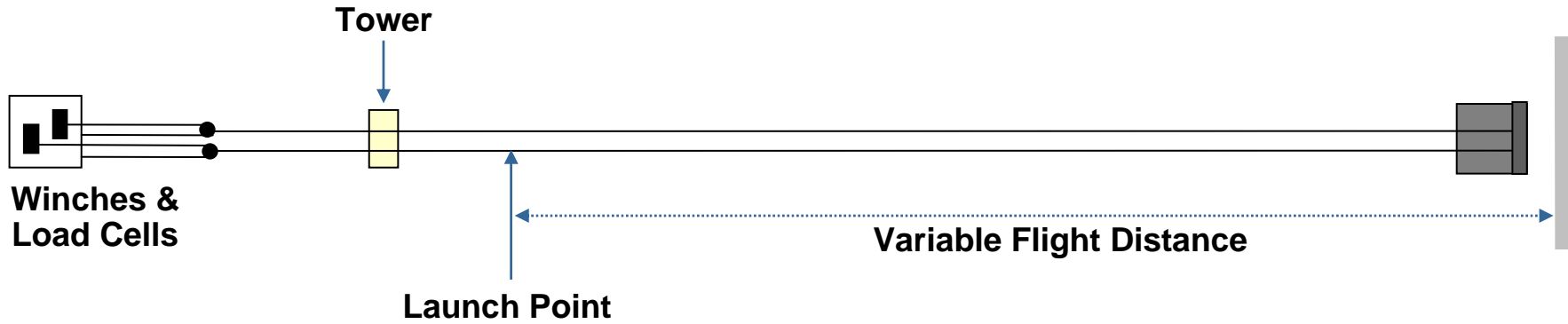
## CAPABILITIES TO DATE

- Velocities > Mach 2 (710 m/s)
- Launch weights up to 100 lbs
- Release test articles from rope for free-flight environment using linear shape charge rope cutters
- Detonate warheads in flight at precise location using high-voltage screen boxes or ESAD
- Spin warhead independent of rocket motor prior to launch for tactical environment
- Impact MOUT targets for fuze testing
- Velocity predictions within 3 percent





- **What is SMF?**
  - AMRDEC work under Fuze & Power Sources ATO
  - Demonstrate Emerging & Lower-Cost Fuzing Technologies Applicable to Army Rocket and Missile Programs that Survive Harsh Environments Such as Impact with Military Operation and Urban Terrain (MOUT) Targets
- **SMF Testing to Date:**
  - 1 Complete Air Gun Test
    - Initial test; lots of learning took place that day!
  - 10 Partial Air Gun Tests
    - Characterize Air Gun launch environment
  - 17 ROAR Tests



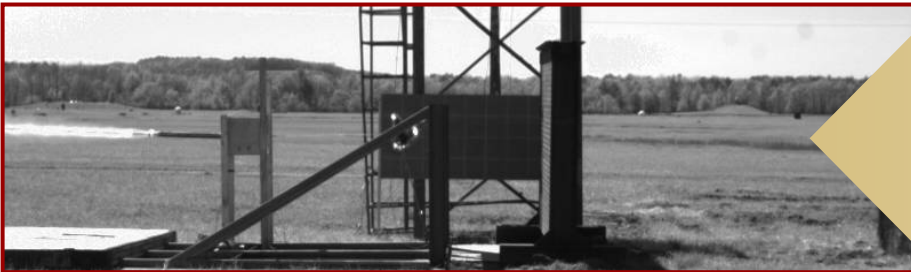
**SMF Round Prior to Firing**



**DRC Target Wall and Celotex/Hay Soft Catch**



**SMF Round on ropes**



**Knifeblades in Screen Boxes used to trigger the initiation of LSC rope cutters**



**SMF Round in free-flight into Brick-over-Block (BoB) Wall**



**SMF Round Exiting BoB Wall Prior to Soft-Catch Impact**