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105mm M393A2 Terminal Ballistic Performance Against Concrete Wall

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Outline

- **Objective/Plan**
- **Performance Tests**
  - **Phase I (Normal Impact – Utility)**
  - **Phase II (Normal Impact at Range)**
  - **Phase III (Oblique Impacts)**
- **Summary**

Wall Breaching
Test Objective/Plan

GOAL: Produce a man-sized hole in a double reinforced concrete wall

Phase I – Evaluate utility of 105mm HEP round to be used as a Concrete wall breaching munitions

Plan: Determine spacing between shots to achieve man-sized hole via numerous shots at 61 meters range

Phase II – Evaluate effect of range on hole size

Plan: *1 shot each at 500m and 1000m with wall at 0 degrees*

Phase III – Evaluate effect of obliquity on hole size and estimate ricochet angle

Plan: *Vary wall angle with 2-3 shots at each angle (~q-50)*

Test Set-Up

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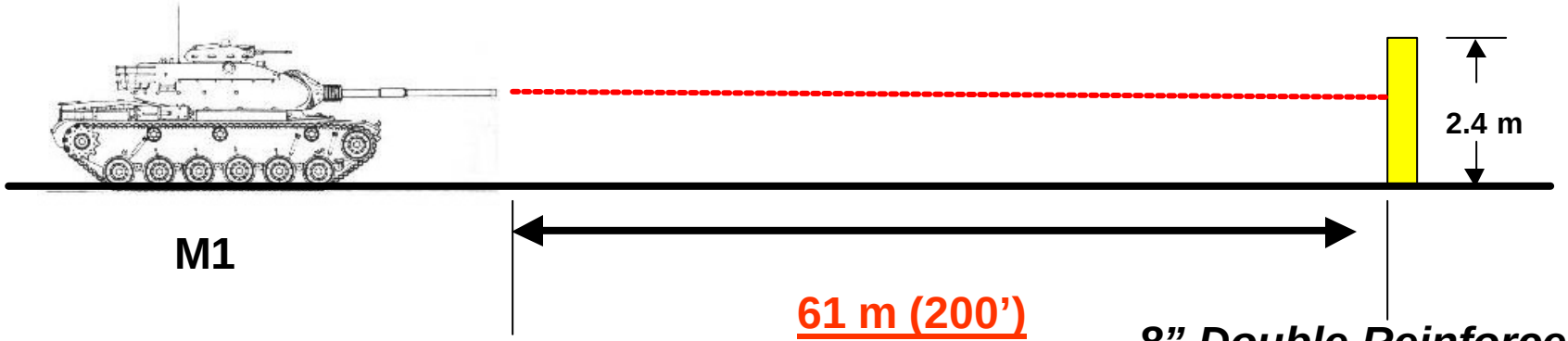
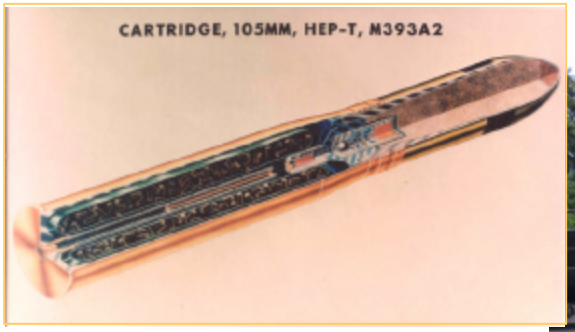


8" Double Reinforced Concrete Wall



105mm M393A2 HEP-T

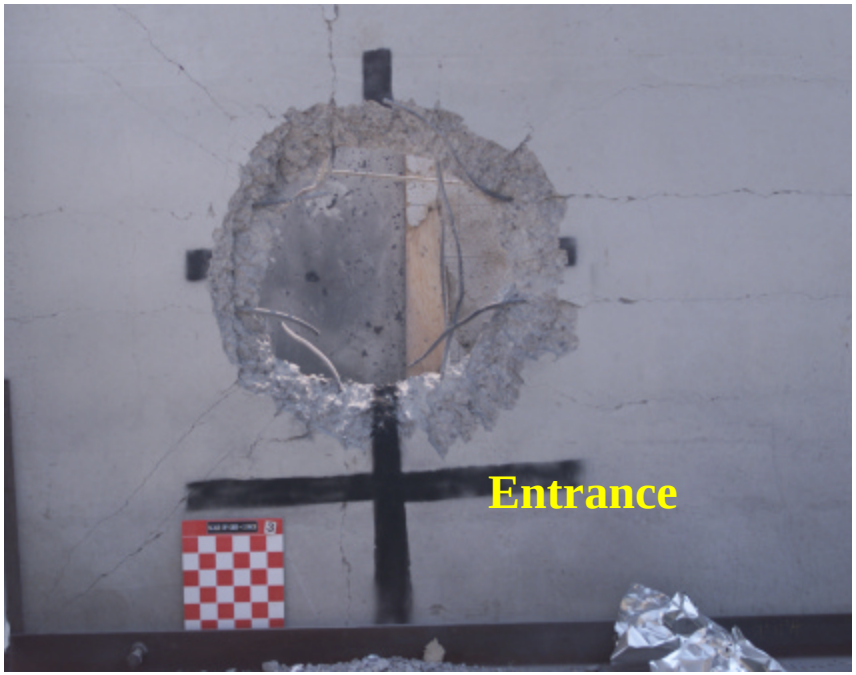
Phase I

Utility of M393A2 for Wall Breaching

Impact on Wall

Shot #1

First Shot
(M393A2 HEP)



Impact point was between Rebar
Hole size is 23” x 26”

Second Shot on Wall
(M393A2 HEP)

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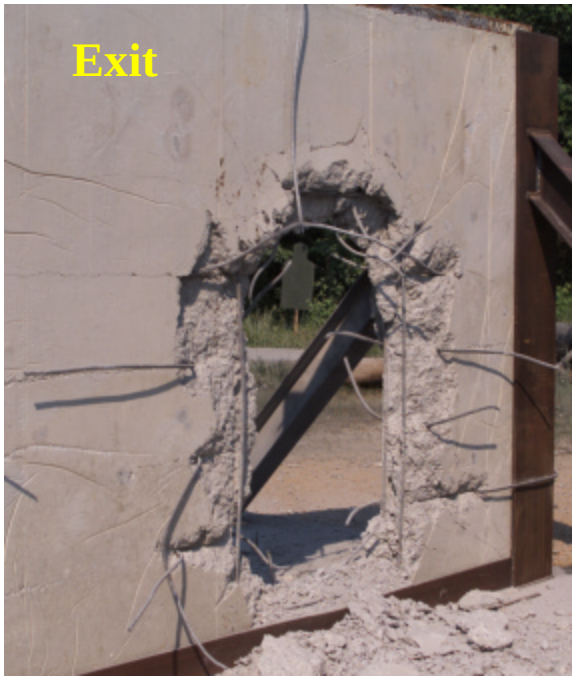

Impact was 28” below center of hole
Hole size is 47” x 20”
Bottom of hole ~8” from ground

Ideal Impacts of M393A2 HEP

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Ideal Impact Locations

Height on Wall

Spacing between shots

Hole Size as a Function of Impact Separation for HEP

Normal Impact at 61 meters

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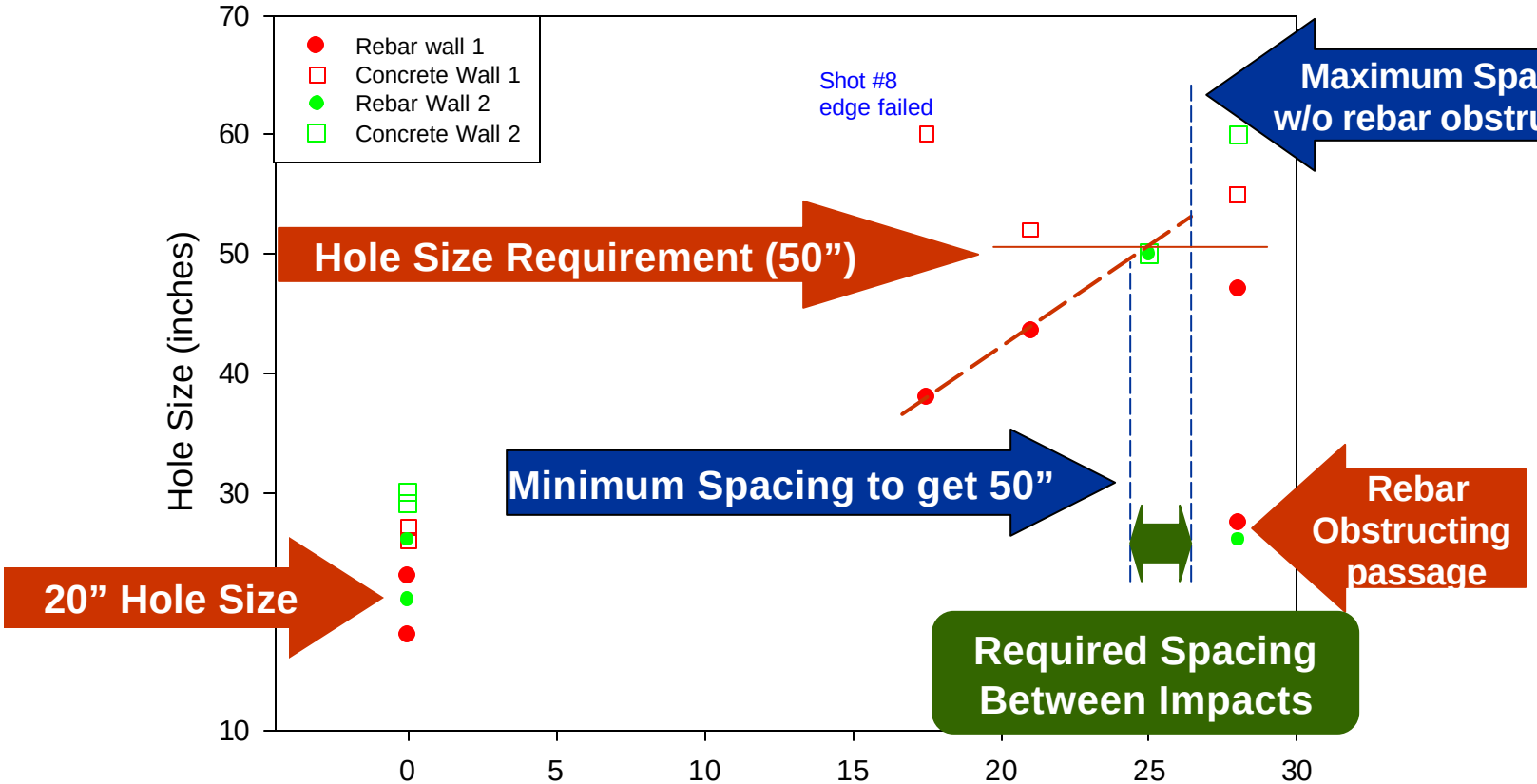


Spacing between two shots must be between 24 and 27 inches to produce a 50" unobstructed hole in wall

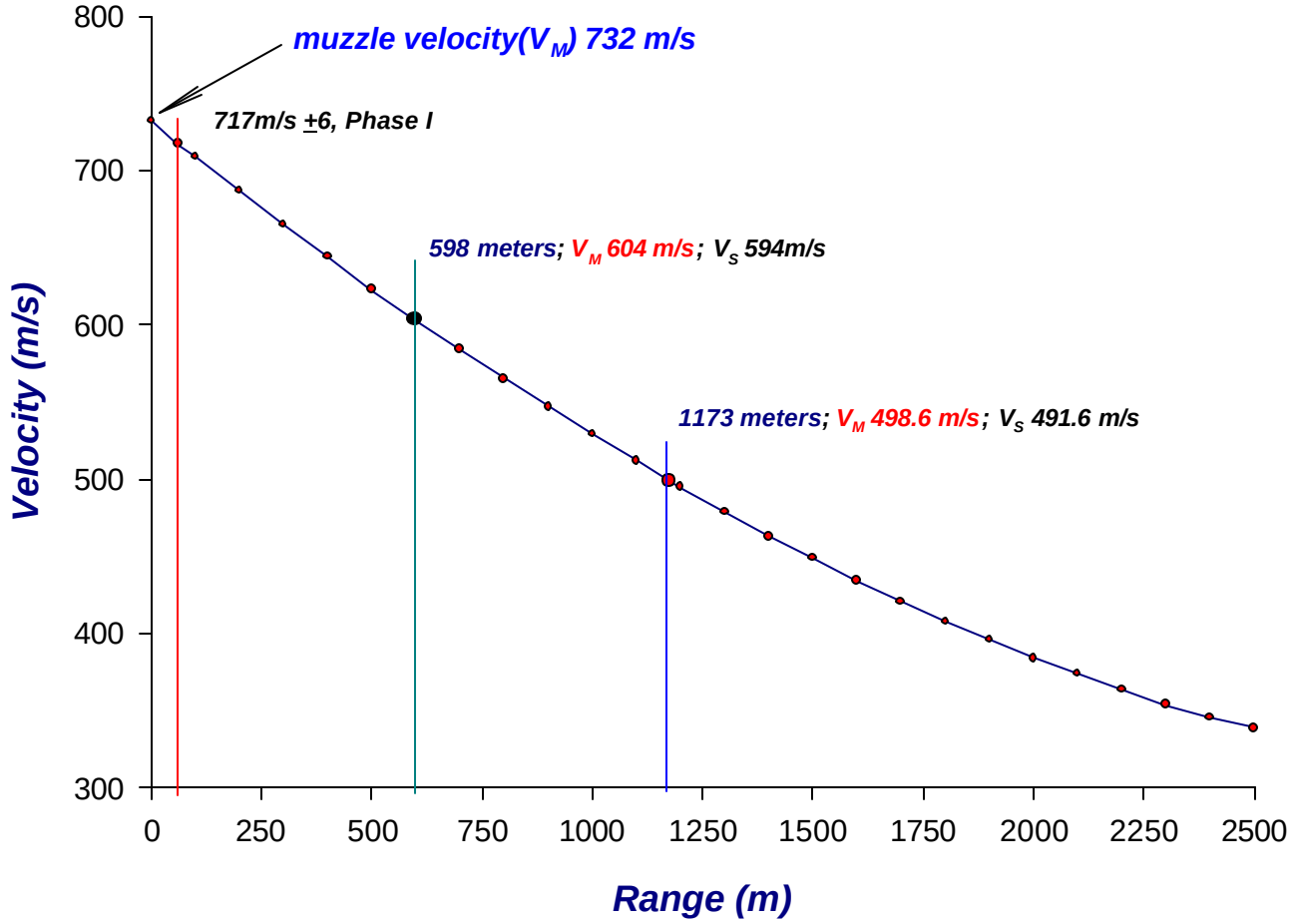
Phase II

Evaluate Variance in Performance with Range

(download propellant to simulate impact velocity at range)

Plan: ***1 shot each at 500m and 1000m with wall at 0 degrees (normal impact)***

M393A2 HEP Velocity Profile as Function of Range



Postmortem Results
Wall Front Scarring

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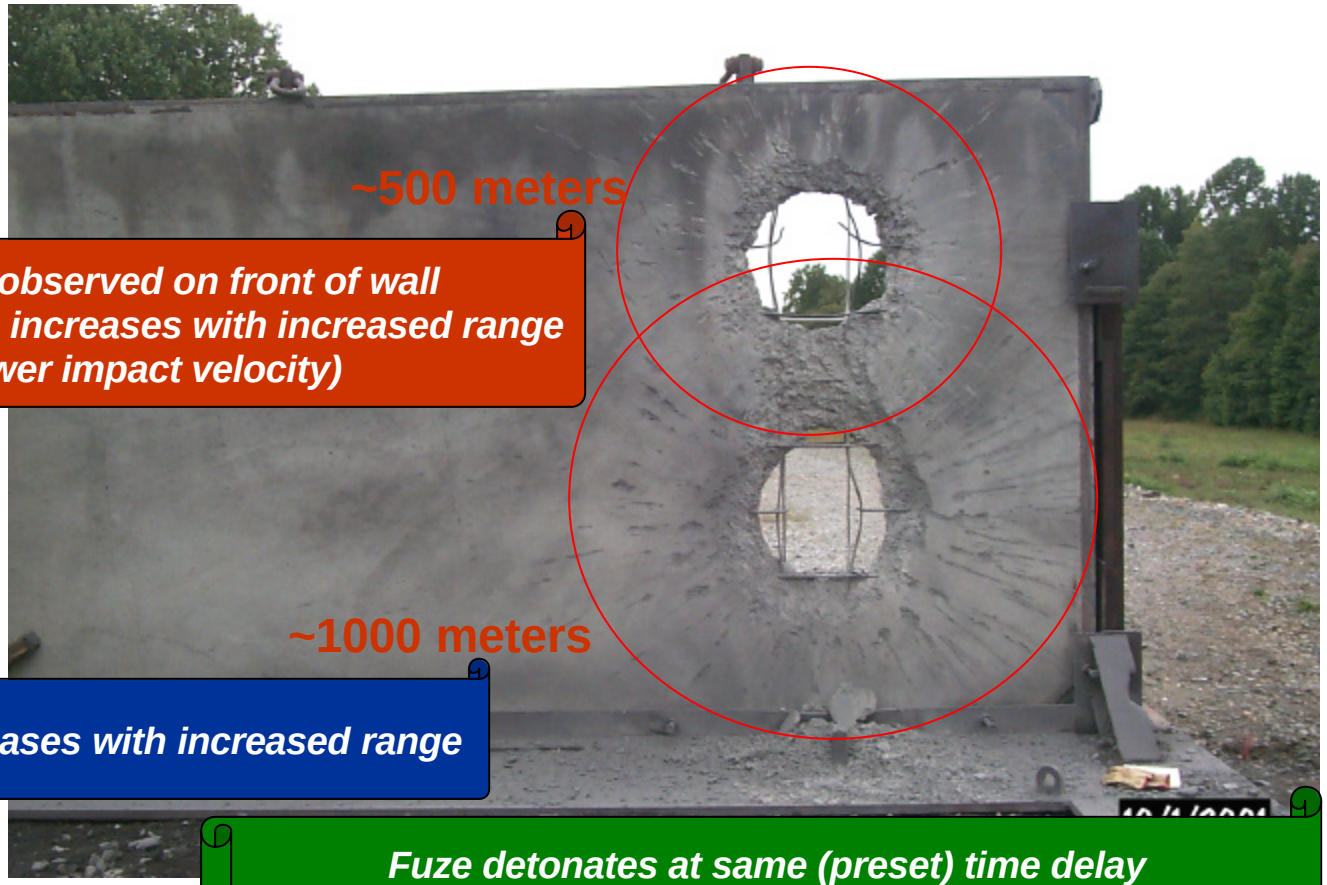
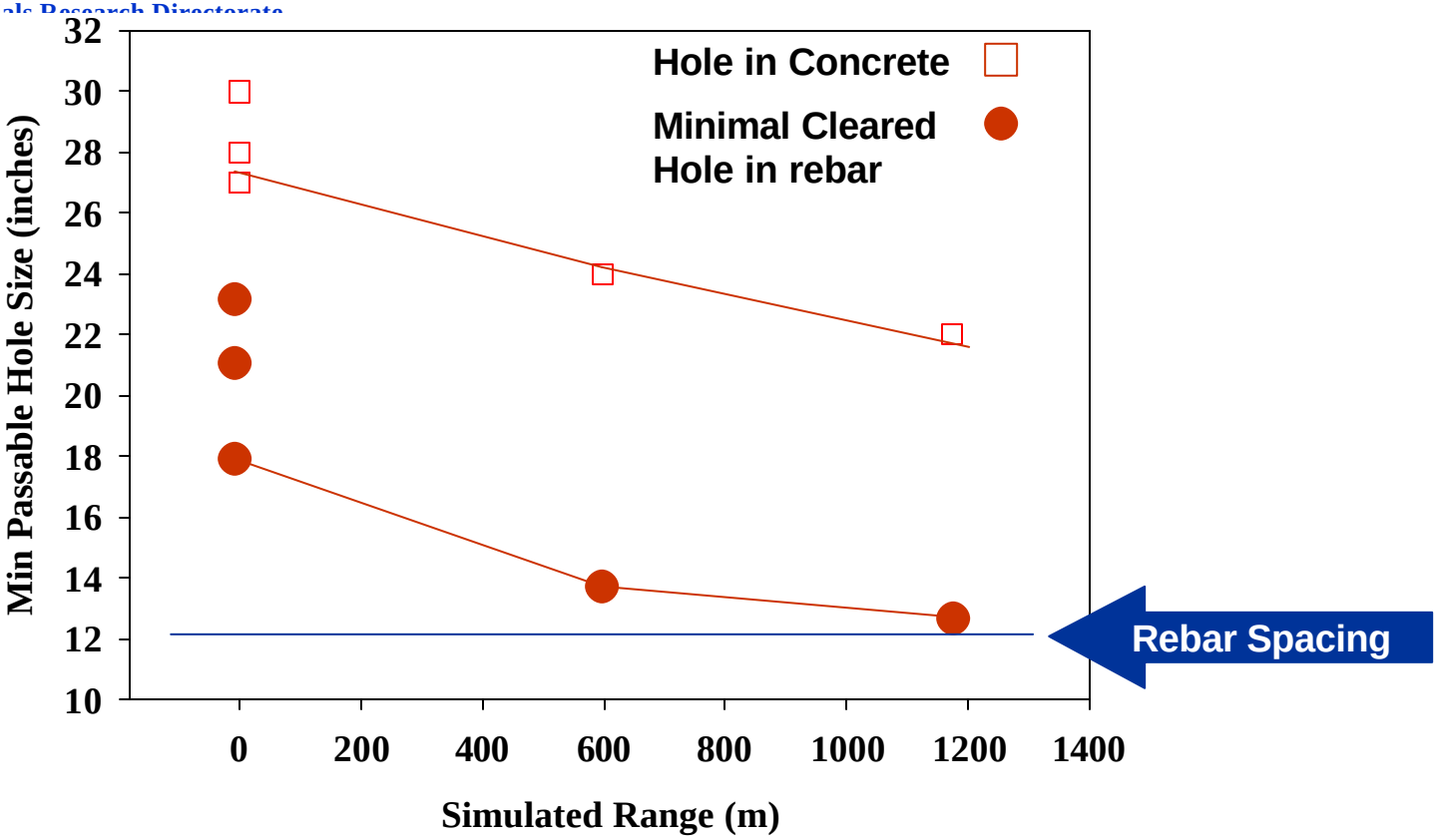


Scarring observed on front of wall
Size of scarring increases with increased range
(lower impact velocity)

Hole Size decreases with increased range

Fuze detonates at same (preset) time delay
At farther ranges, lower impact velocities, the projectile
Is not as embedded as far into the wall when it detonates

Hole Size as a Function of Range



HOLE SIZE DECREASES WITH RANGE:
Lower KE impacting wall
Round does not penetrate wall as deeply before it detonates, so effect of detonation is not as great – more on exterior of wall

Phase III

Determine variance in Performance with Impact Obliquity

Rotate wall to desired obliquity – all at 61meters range

Plan: ***Vary wall angle with 2-3 shots at each angle (~theta-50)***

Expected Impact Obliquity Based on Street Dimensions

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328’ (100m)

200’ (61m)

90’

50’

For a typical street impact angle increases quickly

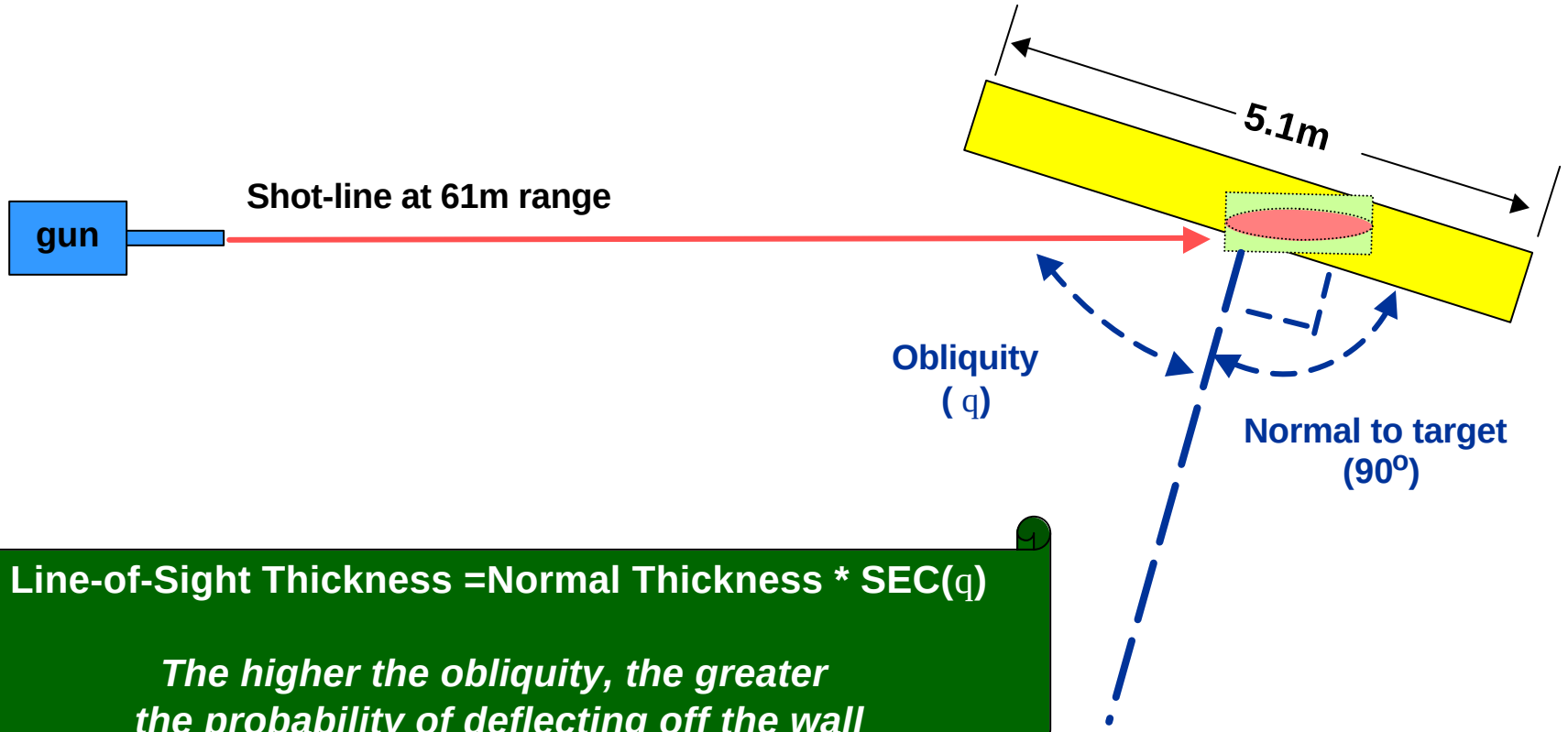
0º 45º 60º 76º 81º

50’ Wide Street

May force engagements to be on corners or straight down to end of the streets

Test Set-up Phase III (Nomenclature)

Overhead View



Line-of-Sight Thickness =Normal Thickness * SEC(q)

The higher the obliquity, the greater the probability of deflecting off the wall

Movie of 45 Degree Shots

Postmortem Results
(45^{o} Shots)

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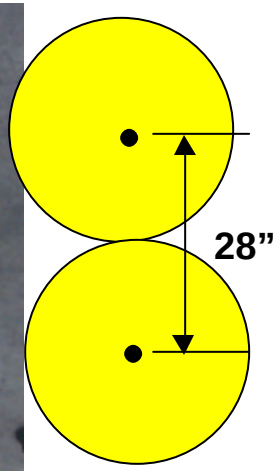

Hole Opening 17.75” x 22”

Hole Opening 20” x 27”(bottom) / 19.5” x 21”(top)

Postmortem Results
(60º Shots)

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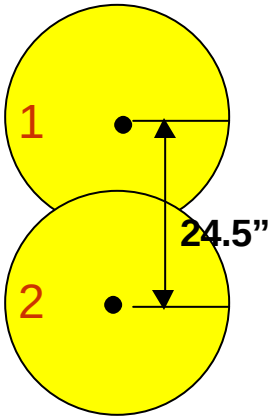
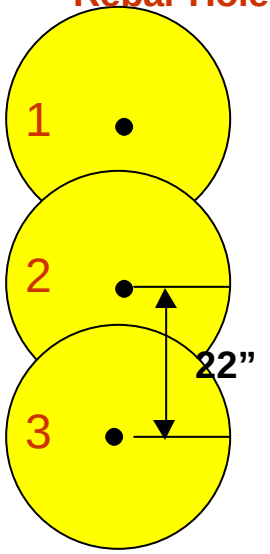
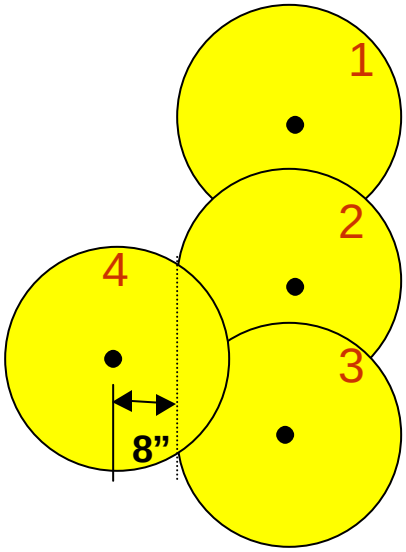
Hole Opening 13.75” x 13”

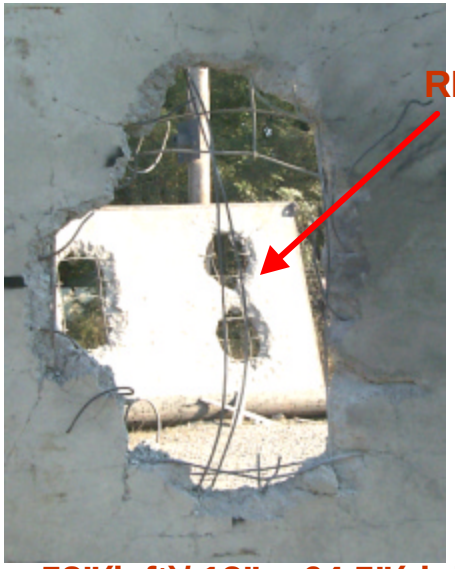
Hole Opening 23” x 24”(bottom) / 21” x 27”(top)



Rebar Hole Opening 22” x 57”







Hole Opening 29.5” x 58”(left)/ 13” x 64.5”(right)

Postmortem Results (80º Shots)

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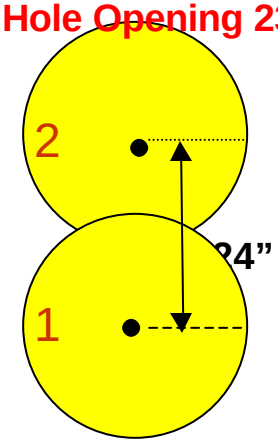
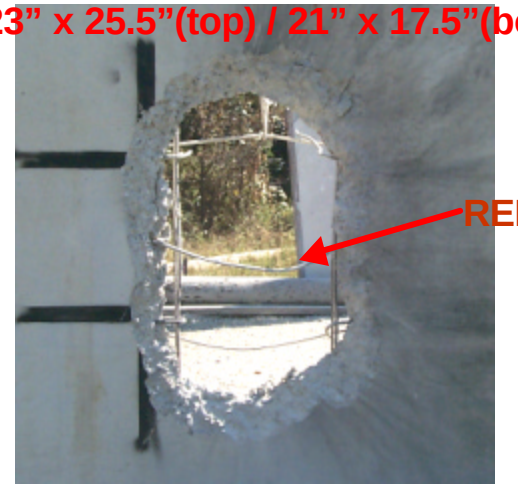
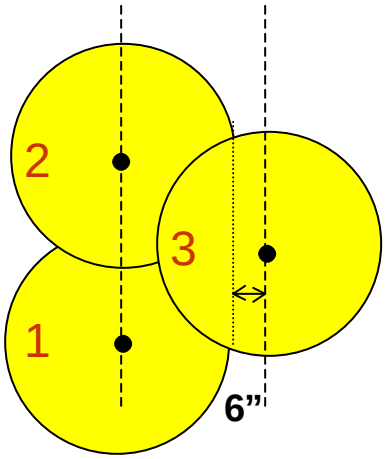
Hole Opening 23.75” x 14”(top)/21.5” x 9”(bottom)

Hole Opening 23” x 25.5”(top) / 21” x 17.5”(bottom)

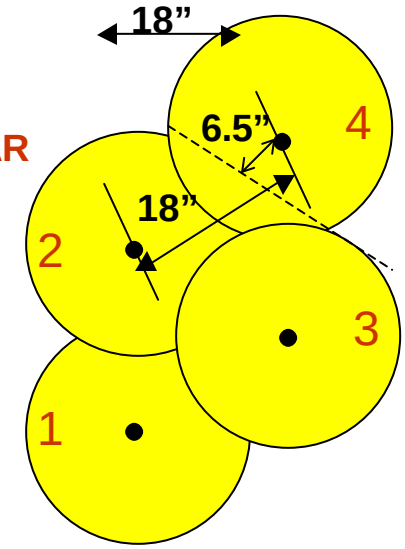






Rebar Hole Opening 34.5” x 34”

Rebar on top could be bent 34.5” x 44” opening



Hole Opening 35” x 56”

Movie of Deflection at 85°

Postmortem Results (85º Shots)

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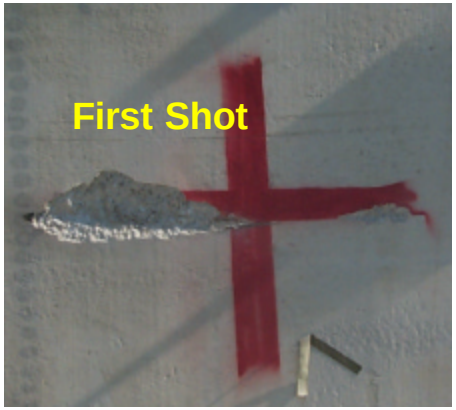


Wall Front

2

15”

1

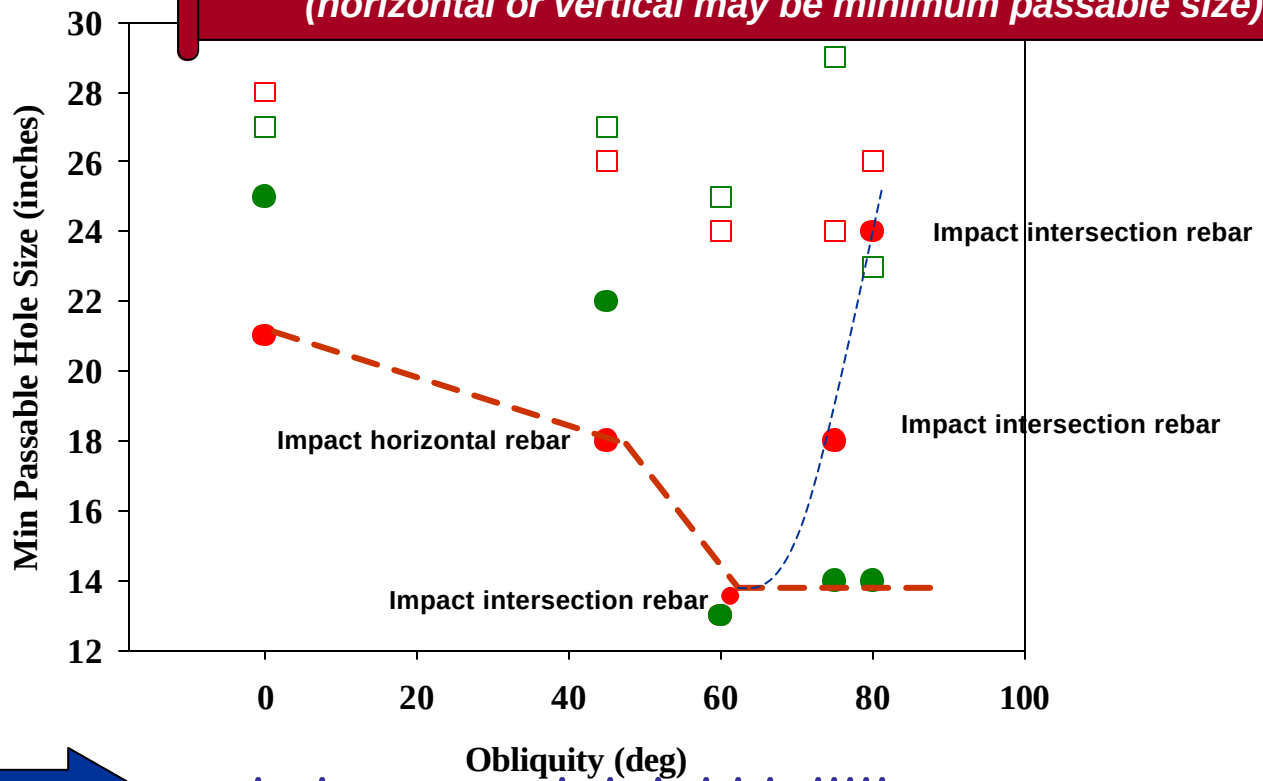
Wall Back

Projectile ricocheted off the wall and detonated down range

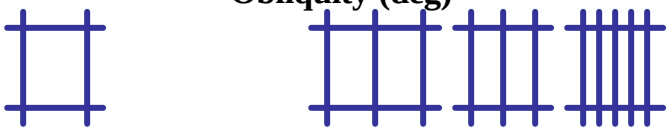
Phase III Results (Single Shot)

Up to 45° - hole size similar for horizontal & vertical spacing (horizontal or vertical may be minimum passable size)

Circle rebar
Square Concrete
Red Horizontal
Green Vertical



Rebar Spacing as Seen at obliquity



Greater than 45°, more vertical rebar removed (larger horizontal hole) because of the angle, projectile has a greater probability of hitting vertical rebar and creating a wider hole

WALL BREACH SUMMARY

- **HEP round will produce sufficient hole size under ideal conditions in 2 shots**
  - ***close range, height on wall, normal obliquity***
- **Hole size is dependent on impact location with respect to rebar**
- **Hole size decreases with increased range**
  - ***projectile functions further into wall at closer ranges***
- **Hole size decreases with increased impact obliquity**
  - ***greater number of rebar to be impacted at obliquity***

QUESTIONS

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