Development of a Movable Wall Shoot House for Small Arms and Grenade Training

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Mr. Brad L. Huntsman, Terran Corporation, Beavercreek, OH
Mr. Joe G. Tom and Dr. Philip G. Malone
US Army Engineers Research and Development Center
Vicksburg, MS
Uses of SACON in Training Facilities

• Background
  – Corps of Engineers has developed different types of shock-absorbing concrete (SACON) for weapons testing and live-fire training
  – SACON is a foamed, fiber-reinforced concrete that will not produce ricochets when fired on

• New Developments
  – New Lower Cost SACON Mixture Produced
  – SACON Tunnel Bullet Traps Installed
  – New Shoot Houses/Grenade House Design with Fixed Self-supporting Panels Produced
  – Moveable Panel Block Demonstrated
Background Information on Shock-Absorbing Concrete

- Corps of Engineers developed different types of shock-absorbing concrete (SACON) for weapons testing.
- SACON has become popular in bullet barriers.
How SACON Absorbs Impacts

- Density is one-half that of conventional concrete
- No coarse aggregate
- Fiber produces toughness
- Concrete crushes on impact
Effects of Multiple Impacts on the Same Point in SACON

- Multiple impacts on the same point do not produce ricochets
- A pocket of debris forms
- The pocket moves deeper into the foamed concrete
- Even in multiple impact most (>85%) of the debris remains in the block
Proportioning of Materials for 90 pcf Polypropylene Fiber-Reinforced SACON

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Cement (ASTM Types I-II)</td>
<td>972 lbs./cu.yd.</td>
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<tr>
<td>Water</td>
<td>466 lbs./cu.yd.</td>
</tr>
<tr>
<td>Sand</td>
<td>972 lbs./cu.yd.</td>
</tr>
<tr>
<td>Stabilizer</td>
<td>0.27 lbs./cu.yd.</td>
</tr>
<tr>
<td>Fiber</td>
<td>14.8 lbs./cu.yd.</td>
</tr>
<tr>
<td>Foam</td>
<td>8.9 cu.ft./cu.yd.</td>
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Increasing density increases strength

Changing the amount of foam added to the sand-cement paste changes the density and strength

Most useful materials are in the 70 to 90 pcf range
Where SACON Can Be Useful

- Live-fire shoot houses and grenade houses
- Bullet traps for lead and/or tungsten (green bullet) recovery on conventional ranges
- Land-based and ship-borne live fire facilities of all kinds
- Barriers for reduction of safety fans in live-fire exercises
- Back-up walls in exercises that use shoot-through materials such as plywood, plastic, glass or sheet metal
Where SACON Can Be Useful (cont.)

- Barriers to collect fragments produced in blasting
- Three-dimensional stationary or movable targets
- Protective structures for video cameras or weapon simulators
- Safe realistic rubble for combat scenarios
Shock-Absorbing Concrete (SACON) Shoot House

- Made with foamed, fiber-reinforced concrete panels
- All metal supports covered
- Metal attachment plates in top and bottom
- No rebar
Interior of SACON Shoot-House

- Safe, no ricochets
- Fire resistant
- Resists vermin
- Can be used with grenades
SACON Huts

- Live-fire training structures
- Realistic exercises with tracers permitted
- Rapidly assembled by bonding cast-on-site SACON panels
- Tip-up construction techniques can be used with SACON
Single-Story SACON Building

- Cast-in-place with continuous formwork
- SACON pumped into formwork
- Door and windows built into the formwork
- Work done with troop labor
Tank Made from SACON
SACON Target
Backstops/Bullet Traps

- Can absorb bullet impacts from thousands of rounds of ammunition
- Tracer rounds and deflagrating rounds can be used
- Alkalinity of concrete reduces lead leaching
- Only practical method of recycling the new “green bullet”
Natural Features Can Be Reproduced in SACON

- Mock-ups of tree stumps, rock crops, and other natural features can be produced

- SACON can be--
  - molded into almost any shape
  - pigmented to have color throughout the object
  - painted to disguise the surface
Conventional berms on a 25-meter range wash out quickly at the bullet impact points.

Maintenance requirements are high.

Lead-contaminated soil washes from range.

Simple, inexpensive, low-maintenance traps reduce the requirement to regrade the berms.

Spent bullets are retained in tunnel--no wash-outs.
SACON Traps and the Green Bullet

- The cost of tungsten requires that the “green bullets” be collected and recycled (common impact areas cannot be used)
- SACON traps offer the best performance in collecting intact bullets
- SACON traps can be made secure to prevent pilfering of tungsten (tungsten is worth $30/lb as scrap, lead is worth $0.30/lb as scrap)
New Movable Wall Shoot House
Panel Design

Movable Wall Shoot House/Grenade House
Panels can be moved with a forklift
Training scenarios can be changed quickly
Can be assembled under cover (warehouse or hangar)
Floor is SACON blocks for better footing

Fixed Wall Shoot House/Grenade House
One training scenario
Crane required for servicing structure.
Roof is not practical
Floor is packed sand

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   - Crane required for servicing structure.
   - Roof is not practical
   - Floor is packed sand

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Panel Block

Each panel has a pedestal base.

Walls are arranged on a conventional concrete pad that is protected by a 2-ft thickness of SACON.

Can be assembled into any configuration of rooms.

Crane or forklift can be used for positioning.

Floor Block

Not to Scale
Summary

- SACON is prepared using conventional mixers and ordinary Portland cement.
- Water-based foam, fiber and thickeners are the only additional components.
- Extremely versatile -- material has a range of densities and can be cast in any shape or color.
- Construction techniques are similar to conventional concrete (block, pre-cast panels, or cast-in-place).
- Used SACON generally considered construction waste -- non-hazardous and non-flammable.
Summary (cont.)

- Less expensive concrete formulation allows us to do more construction on same budget
- SACON bullet traps reduce range maintenance
- Self-supporting and moveable panels provide safe, realistic training structures
- Approaching the goal of building facilities that allow us to training anywhere, any time using the same weapons we fight with
Points of Contact for SACON

Mr. Brad L. Huntsman
Terran Corporation
4080 Executive Drive
Beavercreek, OH 45430-1061
e-mail blhuntsman@terrancorp.com

Mr. Joe G. Tom
Geotechnical Structures Laboratory
U.S. Army Engineer Research and Development Center
Vicksburg, MS 39180-6199
Phone: 601-634-3278
e-mail tomj@mail.wes.army.mil

Dr. Philip G. Malone
Phone: 601-634-3960
e-mail malonep@mail.wes.army.mil