Virginia Ready-Mixed Concrete Association

ICF Blast

The Northern Virginia Advisory Council of the Virginia Ready Mixed Concrete Association (VRMCA) in conjunction with the Insulating Concrete Form Association (ICFA) participated in a demonstration to show how concrete, specifically Insulated Concrete Forms, could be used in construction to help make structures blast resistant.

We poured 6 "Reaction Boxes", which are 8 foot cubes with one side open, which were subjected to explosives and live ammunition to see how the insulated concrete walls resist blast force. These tests were conducted at the Quantico Marine Corps Base ranges during a three day period from May 6-8, 2003.

The stated objective of the DoD Force Protection Equipment Demonstration is to provide leaders and decision makers from the Department of Defense (DoD), federal Departments and Agencies, and selected state and local law enforcement and corrections agencies the opportunity to observe, and become familiar with, commercial readily available force protection equipment available for procurement and further testing within 90 days of the scheduled demonstration.

Three bases of the boxes were comprised of 4000 PSI (.45 w/c) concrete using welded wire fabric and #4 rebar. The other three used Fibermesh synthetic fibers at the rate of 3 lbs per yard along with the #4 rebar .

The walls for each box were made from different manufacturers of Insulated Concrete Forms(ICF) walls using a 4000 PSI pea gravel mix. The Department of Defense will get a chance to see how different ICF engineering will resist the blasts. Some ICF manufacturers use a post and beam system, others use a waffle system and others just place the concrete between two Styrofoam walls with structural rebar.

The ICF manufacturers represented were: **Arxx Building Products, Amvic, American ConForm, Quad-Lock, Eco-Block, and Reward Walls**

The top of the box was made up of 4000 PSI pea gravel mix using #4 rebar and welded wire fabric.

One side of the boxes will remain open in order to inspect the inside of the vault after the blast.

RESULTS!!!

First day - Blast from 40 feet and 33 feet
8' X 8' X 8' reaction boxes

3/8" aggregate/4000 PSI concrete/16" on center rebar (residential design)

Results - No deflection, no cracking, no spalling of concrete, no structural damage. Minor compression of EPS on face of the wall with only corner pieces of the EPS dislodged.

Second day

Blast at 25 feet and 20 feet
8' X 8' X 8' reaction boxes

3/8" aggregate/4000 PSI concrete/ 16" on center rebar (residential design) Structural fibers

Results - No defection, no cracking, no spalling of concrete, no structural damage. There was significant compression of EPS (Expanded polystyrene) on face of the wall with only corner pieces of EPS dislodged.

Blast at 10 feet - 8' X 8' X 8' reaction box

3/8" aggregate/4000 PSI concrete/ 16" on center rebar (residential design) No structural fibers

Results - No defection, no spalling of concrete, no structural damage. Minimal cracking (cracks less than 2 millimeters across) at corners of reaction box. Significant compression of EPS on face the wall; corner pieces of EPS dislodged; EPS singed.

Blast at 6 - 10 feet - 8' X 8' X 8' reaction box

3/8" aggregate/4000 PSI concrete/ 16" on center rebar (residential design) Structural fibers

Results - No defection, no spalling of concrete, no structural damage. Significant compression of EPS on face of the wall; corner pieces of EPS dislodged; EPS significantly singed. Cracking in an "X" configuration on the face of the box, with no crack more than 2 millimeters across.

Overall assessment and follow-up:

1. EPS significantly reduced the load of the blast by absorbing the energy created by the explosion.
2. Further testing will be preformed at the US Army Corps of Engineers Engineering Research and DesignCenter later this fall.