US Army Corps of Engineers®
Engineer Research and Development Center

Flood Fighting Structures Demonstration and Evaluation Program

Description of Program

Within the United States, sandbags have traditionally been the product of choice for temporary, barrier type flood fighting structures. However, sandbag structures are labor intensive and time consuming to construct. Congress has recognized the need to develop more expedient, cost effective, temporary flood fighting technologies. In House Report 108-357, 2004 Energy and Water Development Conference Report, Congress directed the Corps of Engineers to act immediately to devise real world testing procedures for Rapid Deployment Flood Wall (RDFW) and other promising alternative flood fighting technologies. In response to this directive, the Engineering Research and Development Center (ERDC) developed a comprehensive laboratory and field-testing program for RDFW and two other alternative flood fighting products. Those two products (Portadam and Hesco Bastion Concertainer) were selected based on technical merit from proposals submitted by companies who manufacture temporary, barrier type flood fight products. A standard sandbag structure was also tested in both the laboratory and field to provide a baseline by which the other products could be evaluated.

RDFW is granular filled, plastic grid units that use horizontal and vertical tabs to form a continuous structure. Portadam consists of an impermeable membrane liner that is supported by a steel frame. Hesco Bastion concertainers are granular filled, permeable membrane lined wire baskets that pin together to form a continuous structure.

Flood Fight Structures as Field Tested at Vicksburg, Mississippi
Background to Foreground: Portadam, Hesco Bastion, Sandbags, RDFW

Laboratory testing was conducted in a controlled setting but under conditions that emulate real world flood fighting. Stringent construction, testing, and removal protocols were developed for the laboratory. The protocol included both performance parameters (hydrostatic testing, hydrodynamic testing with waves and overtopping, and structural debris impact testing) and laboratory setting operational parameters (time, manpower, and equipment to construct and disassemble, suitability for construction and disassembly by

unskilled labor, fill requirements, ability to construct around corners, disposal of fill material, damage, repair, and reusability).

Field-testing was conducted at the Vicksburg Harbor at Vicksburg, MS. Protocols were developed for the field tests to include construction, testing, and removal. The protocol included performance parameters (hydrostatic testing and hydrodynamic testing (overtopping)). The field testing also included the same operational parameters that were evaluated for the laboratory testing but also included footprint and right-of-way requirements, durability, adaptability to varying terrain, performance on various surfaces (freshly graded, natural vegetation (grass and weeds)) and ability to be raised.

Based on the lab and field-testing, product strengths and weaknesses were observed. The strengths of a sandbag structure include low cost (generally constructed by volunteer labor), conforms well to varying terrain, low seepage rates, and can be raised if needed. The weaknesses of a sandbag structure are that these structures are very labor intensive and time consuming to construct and sandbags are not reusable. Portadam's strengths include ease of construction and removal (time, manpower, and equipment), low seepage rates, no required fill, high degree of reusability, and limited right-of-way required. Portadam's weaknesses include that the membrane liner punctured during the laboratory debris impact test, a Portadam structure can't be raised in a typical application, and Portadam structures are not applicable for high wind use . Hesco Bastion's strengths include ease of construction and removal (time and manpower), low cost, high degree of reusability, and a Hesco Bastion structure can be raised if required. Hesco Bastion's weaknesses include the need for significant right-of-way due to the addition of granular fill with machinery perpendicular to the structure and the Hesco Bastion structure had high seepage rates. After completion of the testing, Hesco Bastion evaluated the high seepage rates and determined that these rates were the result of incorrect installation. RDFW's strengths are ease of construction (time and manpower), low seepage rates, high degree of reusability, can be raised, and provides height flexibility since the units are 8 inches high. RDFW's weaknesses include significant right-of-way required due to the placement of granular fill, high cost, and time consuming to remove. Upon completion of the testing, RDFW evaluated more effective methods for extracting the sand fill from the units. As a result, RDFW has acquired access to a suction trailer that they plan to make available to users of their product to assist in the extraction of the sand.

Pilot testing of the Portadam, Hesco Bastion, and RDFW products is currently being planned for FY 2005 and FY 2006. This testing will be conducted at three sites across the country and will allow for product evaluation under different conditions than those experienced for the Vicksburg, MS field-testing. Five thousand linear feet of each product has been purchased. Equal quantities of each product have been distributed to the 3 host Districts. The purchased products will be dedicated to the pilot testing sites first. Any remaining product will be stored within the host District and made available to all Corps Districts within that geographic region for use during actual flood events. The host Districts are Philadelphia / Baltimore, Omaha, and Sacramento. The pilot testing on the east coast will be a joint effort between the Philadelphia and Baltimore Districts. The site is located on the Susquehanna River at Wilkes-Barre, Pennsylvania. Five hundred foot long structures were constructed at this site during November 2005. The Susquehanna River rose high enough for testing on 30 November 2005. ERDC researchers are currently evaluating the test data. The pilot test site in the Omaha District is located on the Missouri River near Brownville, Nebraska. Four hundred foot long structures were constructed at this site during July 2005. Testing will be conducted as soon as river stages permit. Sites within the Sacramento District are currently being evaluated with site selection scheduled to allow for 2006 construction. During May 2005, the Sacramento District furnished 1000 linear feet of both the Hesco Bastion and RDFW products to Cedar City and Iron County, Utah for use with snowmelt flooding. During the flood, 465 linear feet, 16 inches high of the RDFW product was deployed to help protect a subdivision from flooding. None of the Hesco Bastion product was deployed. During September 2005, 1680 feet of the Hesco Bastion product and 855 feet of the RDFW product were shipped to New Orleans in

advance of Hurricane Rita. Approximately 1,200 feet of the Hesco Bastion product were deployed at 3 locations as part of temporary repairs to levees/floodwalls that were damaged during Hurricane Katrina.

Expected Products

The need for expedient, temporary flood fight technologies requires the demonstration and evaluation of innovative flood fight products. The flood fighting community is not readily willing to use these products during real world flood events until the products have been tested under the conditions that are characteristic of their floods. The laboratory, field, and pilot testing will provide data on the technical soundness, operational functionality, and economic feasibility of these products under varying conditions. The results will be placed on a publicly accessible web page and will provide the flood fighting community a better understanding of the available products and supporting information to help in the selection of the product that best suits their temporary flood fighting needs.

Potential Users

Federal and non-Federal flood fighting communities.

ERDC Principal Investigators

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Participating ERDC Laboratories

Coastal and Hydraulics Laboratory (CHL); Geotechnical and Structures Laboratory (GSL).