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Evaluation of Typar® Geocell Flood Fighting Barrier

Donald L. Ward

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Executive Summary:

The Typar® Geocell from Fiberweb, Inc., uses lightweight geotextile sheets held together to create a series of inter-connected boxes which, when filled with sand, are designed to be used as a rapidly installed barrier to flood waters. In the laboratory tests reported herein, a wall 40 in. high by 54 in. wide with a length of 74.3 ft was assembled in approximately 10 hrs (29.6 man-hrs) by 3 men including the operator of a Bobcat™ front-end loader. Removal required just 2.9 man-hrs. No special equipment or materials were required for either installation or removal, and installation could be easily accomplished by persons unfamiliar with the product with a minimum of training or supervision.

The completed barrier was wrapped in plastic sheeting to minimize seepage past the barrier. Measured seepage rates were approximately 0.025 gpm/ft at a basin water depth of 1.0 ft, 0.08 gpm/ft at a depth of 2.0 ft, and 0.25 gpm/ft at a depth of 3.2 ft.

The structure was not affected by wave action, overtopping, or debris impact in any of the tests reported herein.

The units were not intended for re-use and were destroyed during the removal process. Cost of a 1,000 ft wall, 40-in. high, including 3 frames for use during the assembly, is about $22/ft (Oct 2010).

1 Summary

The Typar® Geocell flood barrier from Fiberweb, Inc, was constructed by a 3-person crew using hand tools and a small Bobcat™ brand front-end loader. Two crews were on station and rotated in to spell the working team. Construction of the 74.3-ft-long by 54-in.-wide by 40-in. high barrier took 9 hrs 53 min, or 29.6 man-hrs, not including a lunch break.

Shovels were used to place the sand in each cell for the first part of each fill, after which sand was more readily dumped from the front-end loader with minor distribution of the sand by shovels. The time required to fill the units with sand is therefore partially dependent on the type of loading equipment, distance from the sand source to the barrier wall, and number of workers unloading the front-end loader. Total time to construct could be reduced by the use of a larger front-end loader to reduce the number of trips to the sand pile, or by placing the sand source closer to the structure.

The barrier was wrapped in plastic sheeting to reduce seepage and sealed to the wing walls with expanding foam sealant and flashing.

There was no discernable movement of the barrier during the filling of the basin and no indications the barrier was not completely stable throughout the tests.

Seepage rates are shown in Figure 1 for the hydrostatic tests in week 1 of the testing (1.0 ft, 2.0 ft, and 3.17 ft depths) and in week 2 at the start of the hydrodynamic tests at low water (2.22 ft depth) and high water (2.67 ft). Seepage rates for the two weeks are consistent. On disassembly it was found that much of the seepage, at least at high water levels, was coming through one seam between adjacent Geocell units that may have been loosened during construction. At a basin depth of 2.88 ft, it appeared that one-half the seepage was coming through this one seam.

Tests with waves, overtopping, and debris impact had no noticeable effect on the structure.

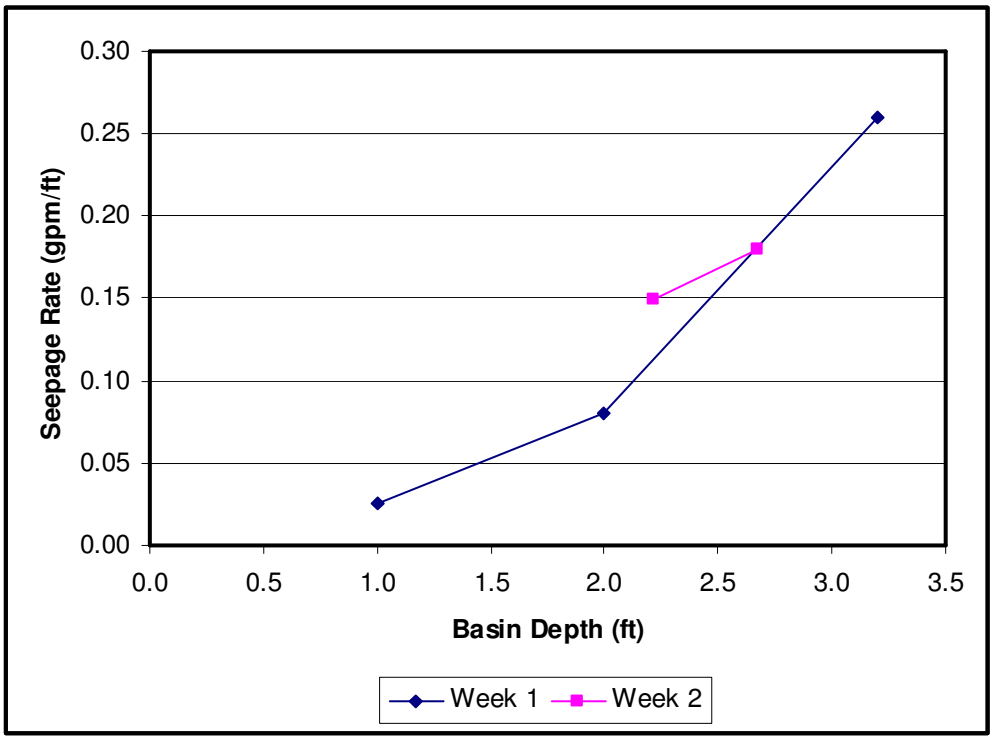

Figure 1. Summary of seepage rates. Week 1 included the hydrostatic tests. The points from Week 2 were at the start of the small waves test at low water and high water.

Disassembly was extremely quick using only shovels and the Bobcat™ front-end loader, this time equipped with forks part of the time and bucket part of the time. Total time to disassemble the structure and conduct general cleanup of the site was 2.87 man-hrs.

Table 2. Summary of Tests with Typar® Geocell.

Test	Measurements
Construction/Repairs/Disassembly	
Construction (man-hrs)	29.6
Repairs (man-hrs)	n/a
Disassembly (man-hrs)	2.9
Hydrostatic Seepage Rates (gpm/lft)	
1 ft Head	0.02
2 ft Head	0.08
0.95H Head (3.17 ft)	0.26

Other Factors

Constructability and Re-usability

The units were placed without any specialized equipment. The only mechanized equipment used was a small front-end loader/forklift. Because no large equipment or machinery is required, the units could be placed in an area with a minimum right-of-way or over surfaces not suited to heavy equipment. Although the units were placed by factory personnel, it was evident that unskilled labor could easily construct the barrier with a minimum of training or supervision.

Equipment used, in addition to the front-end loader/forklift, included shovels, box cutters, hand tampers, rakes, and wire cutters.

In addition to the sand, supplies required included plastic sheeting, expanding foam sealant, and window flashing.

The units were not intended to be re-usable and were destroyed in the removal process.

The units are designed to be stacked, and a two-unit high stack of DC-2 units was shown to be fully stable. No information is available on the maximum water depth that a wall of units can safely hold back. For water depths greater than the two layers tested, use of the wider DC-3 or DC-4 units should be considered.

Environmental

The geotextile in the Typar® Geocell units is generally inert and can be disposed of safely. However, there is a possibility of the fabric picking up contaminants from the flood waters and require special disposal.

The aluminum framework is environmentally inert and does not require disposal due to its re-usability.

The sand placed within the units will pick up any contaminants carried by the flood waters. In addition, as the sand was removed from the units during disassembly, pieces of geotextile were picked up with the sand and

dumped in the refuse pile. For these reasons, special disposal of the sand may be required.

The expanding foam sealant and the window flashing used to seal the barrier to the wingwalls can be disposed of safely.

Unless contaminants are picked up during the flood, there do not appear to be any special environmental concerns with use of or disposal of a Geocell barrier.

Cost

The cost of 1,000 ft of a Typar® Geocell wall, two layers high, including 130 units of Geocell and 3 frames, is $22,140 as of October 2010.

Comparison to Sandbags Baseline Data

Table 3 compares measured parameters from the Typar® Geocell tests reported herein to baseline data collected in 2004 with a sandbag barrier following the same protocol.

Table 3. Comparison of Typar® Geocells to sandbag baseline data.

	Typar Geocell	Sandbags
Install/Remove	**Man-hrs**	
Construction	29.6	205.1
Repair 1	n/a	2.0
Repair 2	n/a	2.0
Repair 3	n/a	2.0
Disassembly	2.9	9.0
Depth (ft)	**Seepage (gpm/ft)**	
1.0	0.025	0.47
2.0	0.08	0.23
2.85		0.53
3.17	0.26	

The Typar® Geocell barrier outperformed the sandbags in every category:

- Although the sandbag barrier was only 36 in. in height and the Geocell barrier was 40 in. tall, the sandbag barrier took seven times as long to build as did the Geocell barrier, three times as long to remove, and required more heavy equipment.

- The Geocell barrier outperformed the sandbags in seepage rate at every water level tested.

- The sandbag barrier was damaged during tests with waves and failed during the overtopping test; the Geocell barrier was undamaged by waves or overtopping.

2 Conclusions

The Typar® Geocell flood fighting barrier from Fiberweb, Inc, appears to be a cost-effective means of rapidly raising a levee or providing a barrier against rising flood waters. Two layers of the Geocell DC-2 units tested easily held back waters to a depth of 3.2 ft. A barrier of the wider DC-3 of DC-4 units should be capable of holding back deeper waters, but were not tested.

Using no heavy equipment except for one Bobcat™ front-end loader, the 40-in.-high by 74.3-ft-long barrier was constructed in 29.6 man-hrs, or 0.40 man-hrs per ft. This included time spent sealing the ends of the barrier to the concrete wingwalls of the test basin, and included making both a 90-deg bend and 63-deg bend in the planform. Less time would be required to construct the barrier in a straight line as in a more typical application. Removal required only 2.9 man-hrs.

The units are not intended for re-use, except for the aluminum frames used in the construction.

The units are designed such that one man can erect a barrier by hand using only a shovel, and sufficiently lightweight that an entire length of wall can be easily transported in a backpack.

Compared to the baseline sandbag barrier data from 2004, the Geocells were much quicker to install and remove using less equipment, had less leakage at every water level tested, and were undamaged by any test in the series. The sandbags, on the other hand, were damaged during tests with large waves and failed during the overtopping test.