Colorado State University
Engineering Research Center
1320 Campus Delivery
Fort Collins, CO 80523

Geoweb® Cellular Confinement System
Presto Products Geosystems®
Performance Testing – Aggregate Infill

Geoweb® Cellular Confinement Systems with aggregate fill are used for applications such as load support, earth retention, porous pavement, and slope and channel erosion protection. A testing program was carried out at the Colorado State University Hydraulics Laboratory to quantify performance of polyethylene Geoweb® in erosion protection, develop engineering guidelines for product usage, and compare results to rip-rap stabilization procedures for channels.
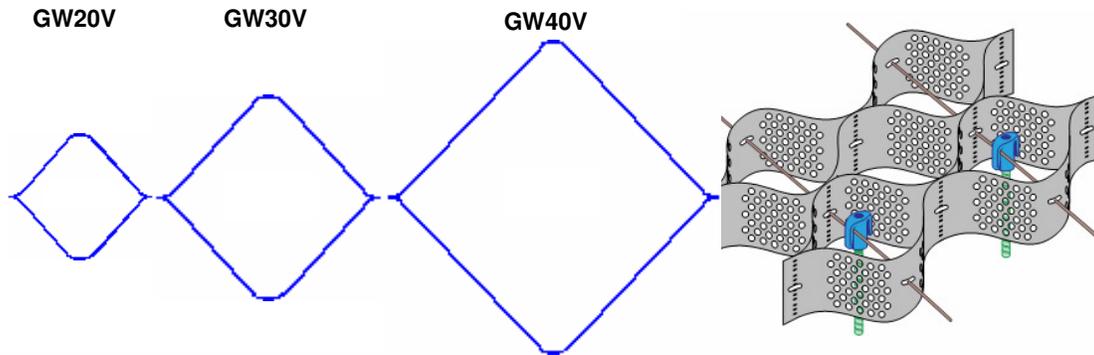
	Geoweb® Cellular Confinement System Cell Type		
	GW20V	GW30V	GW40V
Height (in.)	12	12	12
Approximate Cell Length (in.)	8.8	11.3	18.7
Approximate Cell Width (in.)	10.2	12.6	20.0
Percent Cell Wall Open Area (%)	17.4	13.9	17.2
Nominal Area (in.^{2})	**44.8**	**71.3**	**187.0**

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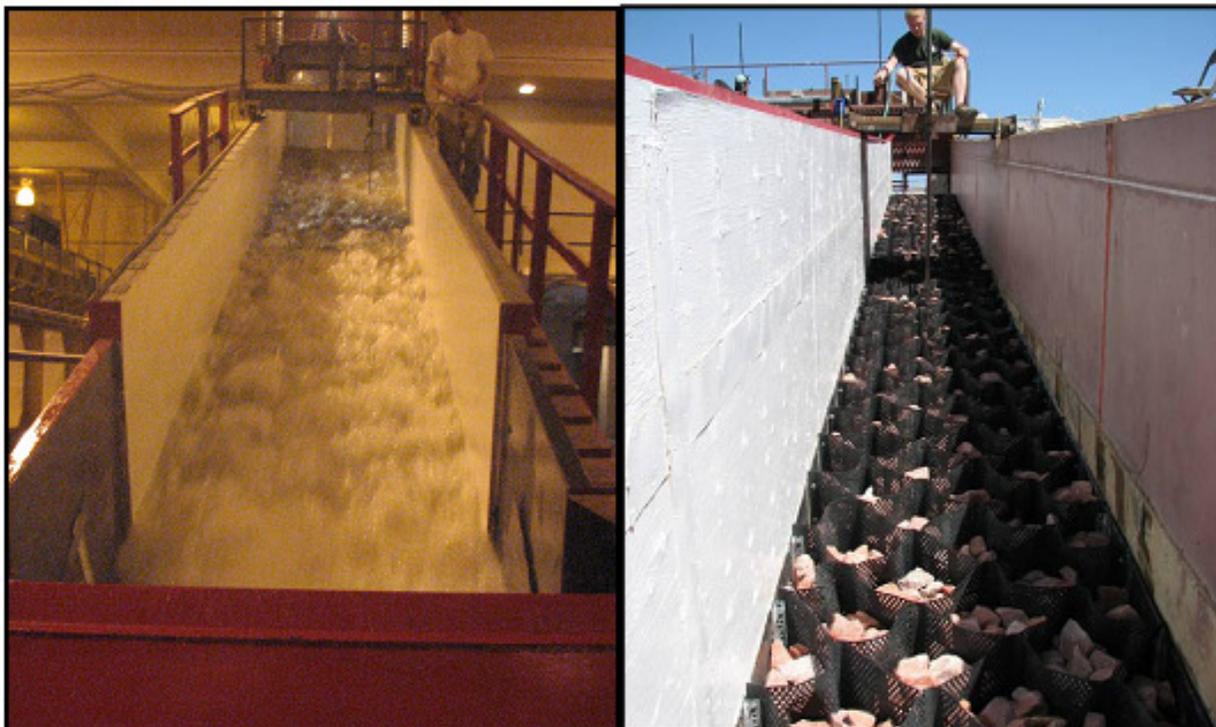
Maximum Hydraulic Conditions Tested

Geoweb® Type	Rock Size in	Hydraulic Data					
		Maximum Velocity (ft/s)	Maximum Shear Stress (lb/ft²)	Maximum Flow Depth (ft)	Maximum Rock Loss (in.)	Minimum Manning n	Maximum Manning n
GW20V	1.14	16.12	9.28	0.91	3.24	0.02	0.04
	3.50	11.50	15.10	1.04	1.61	0.03	0.08
GW30V	1.14	12.01	13.17	0.96	4.09	0.03	0.06
	3.50	11.69	17.98	1.05	1.86	0.03	0.07
GW40V	1.14	16.31	14.85	1.42	5.98	0.04	0.05
	3.50	17.50	15.38	1.79	2.85	0.04	0.05

Design Methodology for Rock Loss

Using data collected from ninety tests, regression analysis was performed to develop a methodology for rock loss within installed Geoweb® as determined by the Clopper Soil Loss Index. The following methodology accounts for 96.5% of the variation in observed rock loss:

$$L = G_B \left(\frac{S^{0.52} q^{0.42} A^{0.37}}{d_{50}^{0.91}} \right)$$

where: L = rock loss (ft); G_B and G_E = Geoweb factors; S = bed slope; q = unit discharge (ft²/s); d_{50} = mean rock size (ft); and A = nominal area of Geoweb® cell (ft²). An envelope relationship was also developed, conservatively predicting rock loss as:

$$L = G_E \left(\frac{S^{0.5} q^{0.4} A^{0.4}}{d_{50}} \right) + 0.03$$

Ranges of testing, and confident applicability to field data are as follows:

S = 2.5% to 51.84%
q = 0.613 to 31.3 ft²/s (max. for GW20V and GW30V = 6.2 ft²/s)
d_{50} = 1.14 to 3.50 in.
A = 44.8 to 187 in²
Specific gravity of rock approx. 2.65

Legend: ▲ Test Points □ Envelope Points — Perfect Agreement
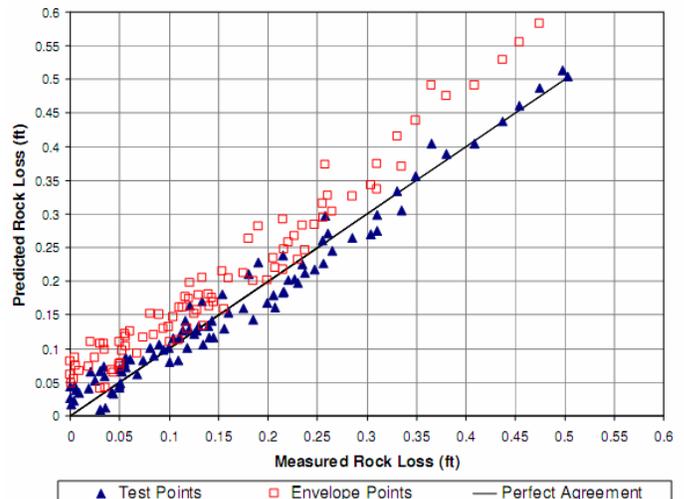
Comparison of Geoweb® to Rip-Rap

Geoweb® was evaluated on its performance as compared to rip-rap with methods commonly used in engineering practice. Results showed that required rock size for aggregate fill with Geoweb® was at least 30% smaller than rip-rap as sized by Abt and Johnson (1991) and at least 50% smaller than sizes recommended by USACE (1994). Comparisons emphasize the ability of the confinement system to outperform rip-rap and its cost efficiency as an erosion-protection method, especially in areas where larger rock is not locally available.