

Tough Turf

Alternatives to hard armor
begin to take root



Marc S. Theisen

Vegetation is the most accepted method for protecting against erosion. However, when sites exhibit extreme conditions where high-flow velocities and shear stresses exceed the limits of natural vegetation, “hard armor” is often assumed to be the only answer. Riprap, concrete, gabions and flexible concrete mats are some of the typical heavy-duty engineering answers to soil stabilization in extreme conditions. Levee armoring, cut hillsides, pond banks, water channels and spillways are a few examples of what once was the sole domain of hard armor.

As engineers and contractors look for more environmentally friendly and cost-efficient alternatives, however, enhanced vegetative solutions increasingly are being used in areas where hard armor once ruled.

Turf reinforcement mats (TRMs) are capable of handling high-stress loads associated with storm events. TRMs are composed of non-degradable, ultraviolet and chemical-resistant synthetic polymers, such as nylon and polypropylene, that are oriented into a flexible three-dimensional matrix. The most effective TRMs provide a lofty three-dimensional matrix with up to 95% open space. The open space is infilled with soil or a high-performance flexible growth medium. Infilling a TRM reduces the impact of water on the soil surface, ensures ideal seed-to-soil contact and provides a superior environment for more rapid and complete seed germination and vegetation establishment. Once vegetation is firmly established and roots are intertwined within the TRM, a “green armor” system is created that can perform equal to or better than hard armor in many applications.

The application of enhanced vegetative solutions became more prevalent with the advent of high performance-turf reinforcement mats (HP-TRMs). HP-TRM design includes integration of a high-tenacity polyester geogrid within thermally fused and entangled nylon monofilaments, creating a homogeneous,

three-dimensional structure with no loose fibers, threads or nettings.

High-performance turf reinforcement systems can handle the stress loads once reserved for hard armor. Prior to the introduction of HP-TRMs, hard armor was used exclusively to accommodate sites where velocities (up to 8 ft/sec) and shear stresses (up to 3 lb/sq ft) exceeded the limits of natural vegetation. Today, “green armor” systems raise the limits of vegetation to velocities in excess of 30 ft/sec and shear stresses of 20 lb/sq ft, according to testing conducted at Colorado State University Engineering Research Center Hydraulics Laboratory.

For the most severe conditions, an HP-TRM can be permanently anchored to the soil with percussive driven earth anchors (PDEAs) to create an “anchor armor” system. PDEAs offer lightweight, corrosion-resistant anchorage that can be driven from ground level using conventional portable equipment. Their installation creates minimum soil disturbance and can provide additional geotechnical stabilization. Combining an HP-TRM with PDEAs provides a unique solution for demanding applications, including levee armoring, steep slope and channel stabilization, canal and shoreline protection, and slope failure repairs.

TRM-enhanced vegetation solutions offer aesthetically pleasing, environmentally friendly alternatives that are one-third to one-half the cost of hard armor. According to the U.S. Environmental Protection Agency, TRMs elevate the erosion resistance of natural vegetation, capture more runoff and increase infiltration while filtering sediment and other storm water pollutants. **SWS**

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