

LANDLOK® REPORT

An Erosion Control Case Study From SI® Geosolutions

Landlok® Turf Reinforcement Mat Keeps Hawaiian Interstate Project on Track

Background

Construction of the award winning H-3 Interstate project was the largest public works undertaking in Hawaii's history. This 26 kilometer (16 mile) stretch of highway transects the island of Oahu providing motorists some of the most spectacular scenery in the Hawaiian Islands. The project required almost two decades to complete at a total cost of more than 1.3 billion dollars. It included two tunnels, more than 25 bridges, and steep cut/fill slopes through rugged mountain topography.

The Challenge

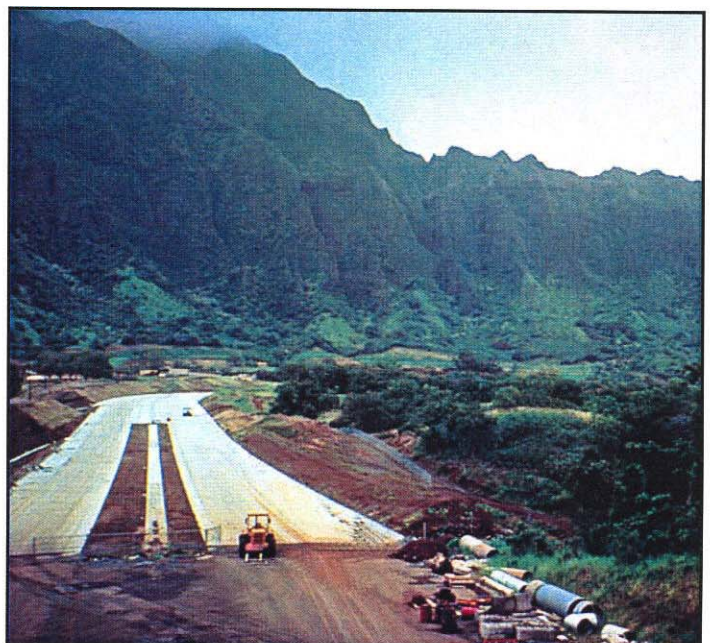
Hawaii Department of Transportation (HDOT) officials and the H-3 design team were faced with numerous challenges prior to and throughout the construction period. Many environmental and citizen groups attempted to block the project before it even began because of concerns over the effect this major construction project might have

on the surrounding countryside. It was feared that creeks, rivers, and bays would be filled with sediment and the beautiful mountains would be scarred forever. Therefore, erosion prevention and site reclamation became a major focus in the design and construction effort.

To compound the situation, this part of Oahu receives over 300 centimeters (120 inches) of rainfall annually, often coming in the form of short duration, intense downpours. Traditionally, overall erosion rates in Hawaii are relatively low, but even Hawaiian soils and rock can become susceptible to erosion when exposed to the elements and, in many cases, may lack sufficient nutrients to support rapid re-vegetation. Without costly soil amendments, vegetation establishment in some areas requires two (or more) complete growing seasons. When coupled with cut and fill slopes, some steeper than 1 to 1, and lengths in excess of 100 meters (330 feet), this presented a formidable challenge for the design team.



This site presented major aesthetic challenges in preserving this breathtaking Oahu Landscape (right). Landlok® TRM 435 is installed on a moderate slope (above).



And finally, due to the concern of the Hawaiian people, HDOT required erosion protection materials be not only effective, but also aesthetically pleasing. Thus, materials and techniques that did not blend with the tropical landscape were considered unacceptable.

The Solution

Over the two-decade scope of the project, various slope protection techniques were tested on the H-3 project, including hydraulic seeding and mulch, temporary and permanent rolled erosion control products (RECPs), and hard-armor (shotcrete). While temporary protective measures, such as mulch alone and degradable RECPs, were effective on shallow slopes, these products did not meet the challenge on steep slopes. Hydraulic seed and mulch simply washed away under the intense rainfall, and temporary RECPs degraded too quickly to provide sufficient long-term protection.

Shotcrete was utilized effectively on some very steep slopes. However, this material proved very costly and did not provide the aesthetically pleasing appearance desired by the communities.

After a long trial and error process with these traditional methods, Landlok® TRM 435, a permanent turf reinforcement mat (TRM), manufactured by Synthetic Industries, provided the most cost-effective, aesthetically pleasing solution. This relatively light-weight TRM, designed primarily for slope protection, consists of a dense web of green colored polypropylene fibers positioned between



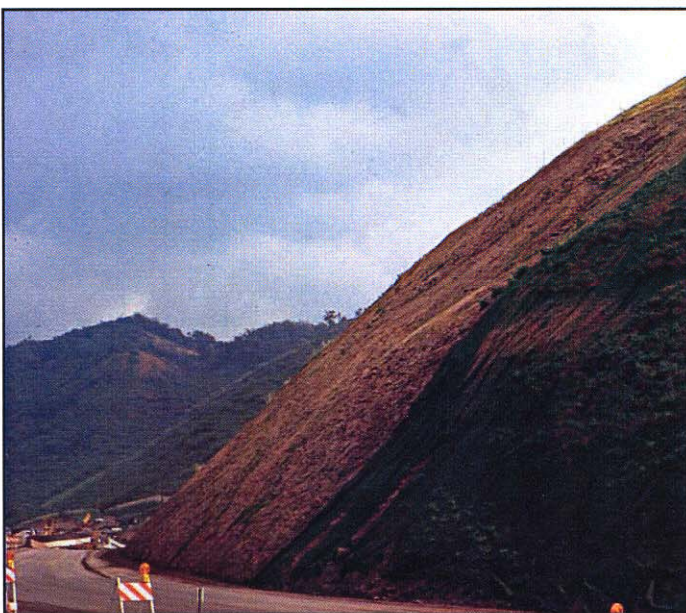
Landlok® TRM 435 used to limit weathering and raveling of rock cuts

two high-strength nets mechanically bound together by parallel stitching. Landlok TRM 435 is composed of 100 percent synthetic materials that are resistant to biological and ultraviolet degradation.

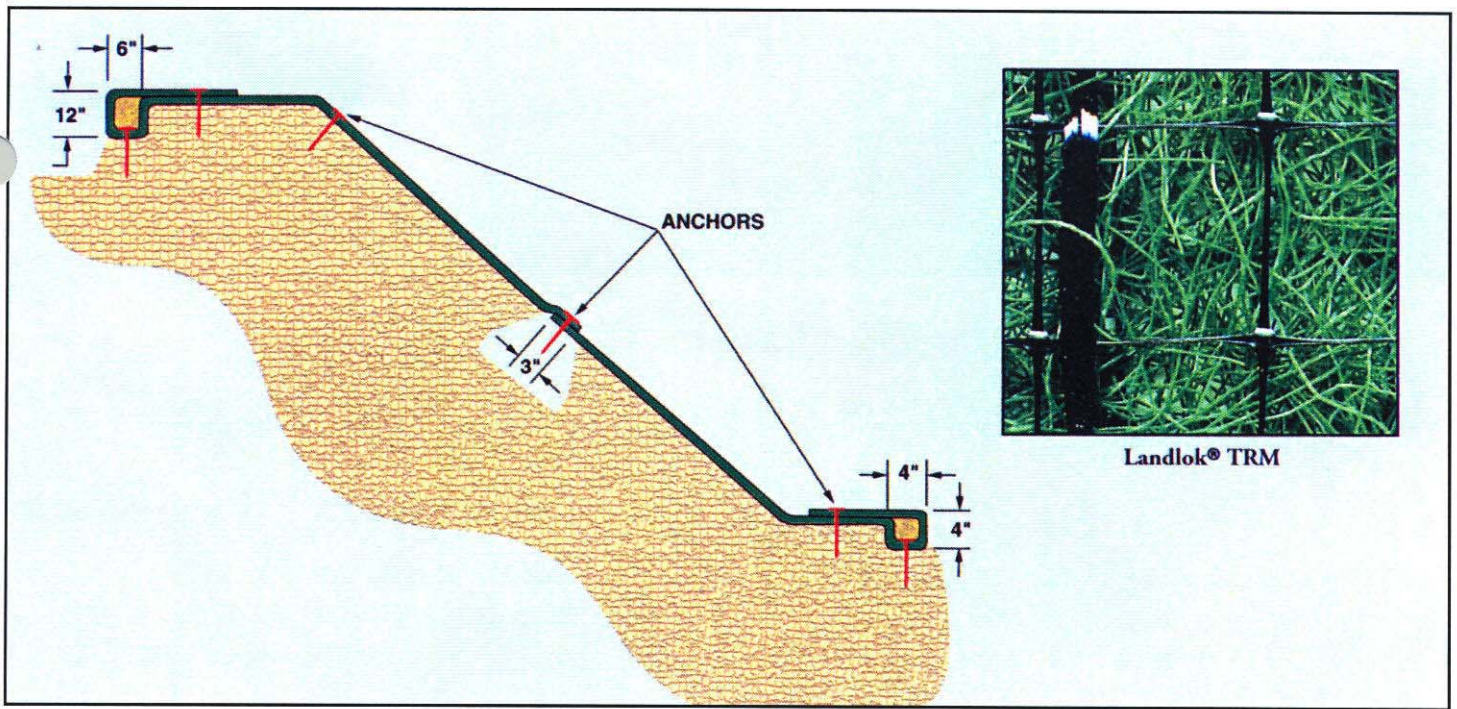
Installation

Not only were the slopes extremely steep, loose soil and jagged rock provided additional obstacles during installation. However, Green Thumb, Inc. (erosion control contractor), effectively overcame these impediments by using local experience and installation suggestions from: Contech Construction Products, Inc. (distributor), Architectural & Engineering Systems, Inc. (local representative) and Synthetic Industries' engineering staff. In most instances, the subgrade was prepared, hydraulically seeded with a specially formulated mixture of native grasses and fertilizer and covered with mulch prior to TRM installation. The TRM was then anchored in a trench at the top of the slope and deployed downward. During deployment, laborers wore rappelling gear and descended along the slope, ensuring proper alignment and overlap of the TRM while anchoring it in place.

45 centimeter (18 inch), steel staples were driven through the TRM to provide slope anchorage in most cases. However, where Landlok TRM 435 was placed over rock cuts, heavy-duty anchor pins were fabricated from 9.5 -millimeter (3/8 -inch) steel rebar. The frequency of anchor pin placement varied from 1.2 anchors per square meter (1 anchor per square yard) to 3 anchors



Over-seeded and mulched Landlok® TRM 435 used on one of the more challenging applications



per square meter (2.5 anchors per square yard), depending on slope steepness and subgrade soil competency. In summary, the high strength and lightweight characteristics of Landlok® TRM 435 proved instrumental in allowing it to be effectively installed in the most severe applications.

Results

Landlok TRM 435 provided initial anchorage for seed and mulch to allow vegetation establishment and permanent reinforcement for vegetation once established. Moreover, the product continues to provide permanent

protection in areas where re-vegetation is slow due to infertile substrate soils and rock. This success led to the use of Landlok TRM 435 on all H-3 slope protection applications which ranged from reducing erosion on shallow slopes to preventing weathering in near vertical rock cuts. In fact, nearly 170,000 square meters (200,000 square yards) of the TRM has been deployed along the H-3 corridor, to date. In conclusion, Landlok TRM 435 provided "Earth stopping Solution" required to help keep the H-3 Interstate Project on track.