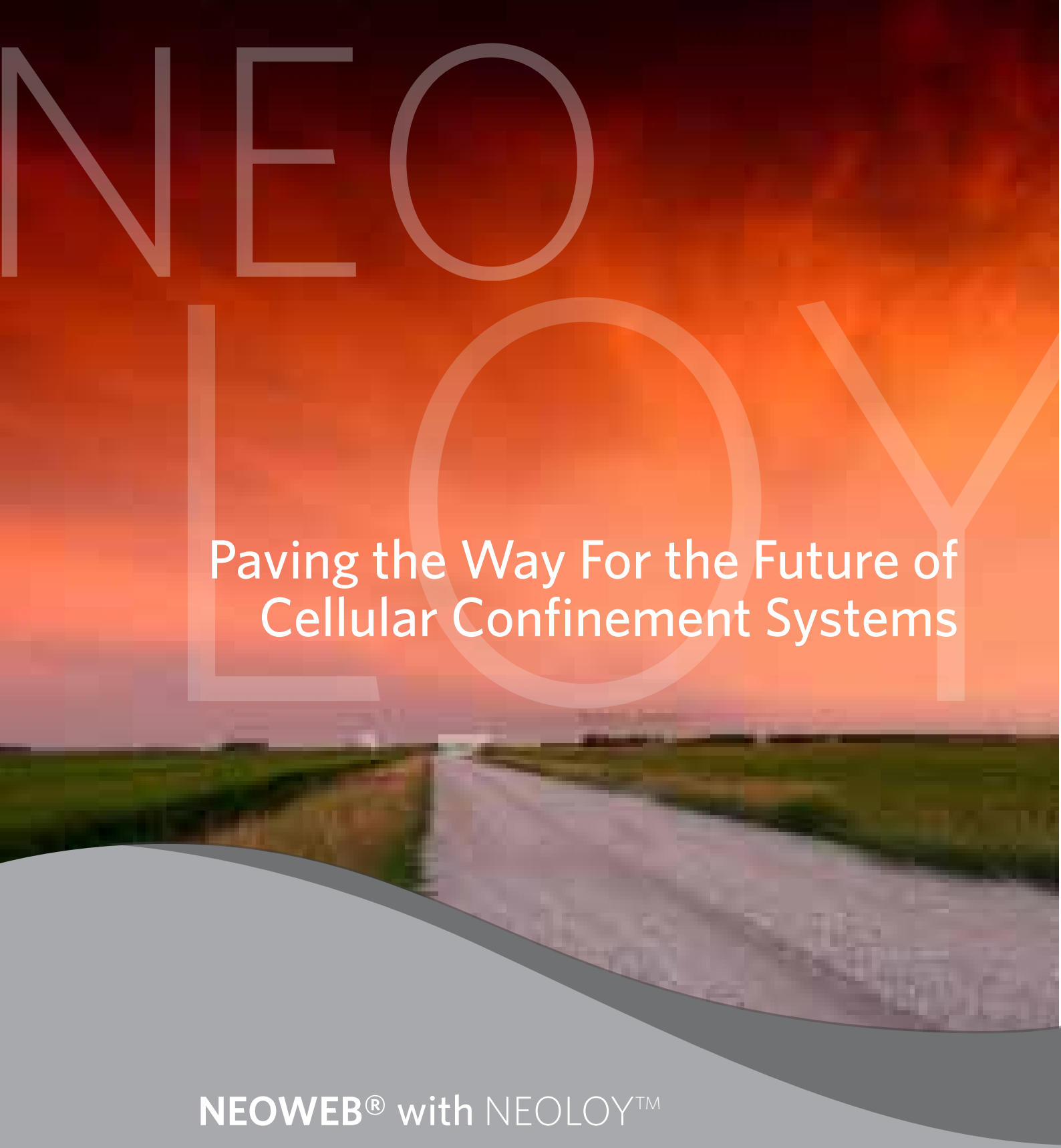


Paving the Way For the Future of Cellular Confinement Systems

NEOWEB® with NEOLOY™

Stabilizing an unstable world!

www.prs-med.com

Neoloy is setting the standard with a new generation of durable and sustainable soil reinforcement solutions

Cellular confinement systems (geocells) were invented by the US Army Corps of Engineers in the 1970's to construct temporary roads for heavy military vehicles over weak soils. Several years later their use for civilian applications was allowed and commercial production began. However, unlike the original application, development of geocells in the civilian engineering market focused mainly on soil erosion control for slope and channel protection.

The use of geocells for load support became a secondary function and was limited to the reinforcement of temporary pavement structures. Geocells were typically deployed in the lowest structural layers, usually the subbase, in order to improve the load bearing of weak subgrade. This conventional approach unfortunately overlooks the very large potential of geocells to reinforce other layers of the pavement structure and provide more permanent long term applications.

Why PRS

BENEFITS
- Highest performance geosynthetic
- Reduce infill quantity by 50% and more
- Utilize local marginal infill and land
- Easy & fast installation
- Reduced maintenance
- Longest term design strength of any geogrid or geocell
- Save time, money, resources

ADVANCED RESEARCH
- Polymeric alloy with highest stiffness and strength available
- Significant investments in R&D and engineering
- Cooperation and testing with leading institutions worldwide
- Highest and most reliable industry standards available

TOTAL CUSTOMER SATISFACTION
- Comprehensive end-to- end consulting and support
- Customer assistance for planning, design and installation

MANUFACTURING
- Largest geocell facility in world
- Guaranteed supply and delivery
- ISO-9001 Certified Quality Control & CE Marking

As a leader in the field, PRS has focused on understanding and advancing cellular confinement technology. The result is a completely new concept – Neoloy™ based Neoweb®. This new generation of geocell from PRS offers performance and design life aligned to the needs of today's transportation infrastructure, and at the same time driving the transition from slope and channel protection to load support applications for highways, railways and ports.

Geocell Reinforcement Principles & Design Methodologies

Introduction to Confinement

Neoweb is a three-dimensional, cellular confinement system in a honeycombed structure. When filled with granular infill, a new composite geosynthetic entity is created from the complex interaction of cell, geometry and soil on three planes, ideal for soil confinement, stabilization and reinforcement solutions.

Neoweb improves the performance of infill materials, while increasing the bearing capacity of structural pavement layers. Stiffness of the infill and cell is increased by the hoop stresses developed on the cell wall as well as by passive resistance from surrounding cells. Confinement prevents movement and shearing of soil infill under cyclic loading, maintains compaction and reduces aggregate attrition.

Design Methods

PRS carried out an intensive R&D program with leading geotechnical researchers in universities, professional institutes and transportation agencies (road and rail) around the world. The results of these studies and the accumulated applied knowledge from around the world have resulted in three different approaches to structural pavement design:

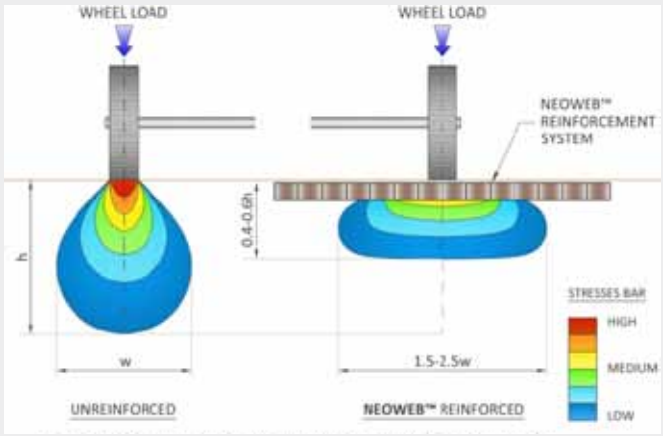
- Beam effect
- SIF - Subgrade improvement factor
- Resilient Modulus

Each approach emphasizes a different aspect of the total contribution of the Neoweb reinforcement to the pavement structure. Calculated values take into account a safety factor, but the actual contribution of reinforcement with Neoweb is even higher.

Beam Effect

Vertical loading on Neoweb infilled with compacted granular material creates a semi-rigid slab or "beam effect" over soft soils. This distributes the load evenly and effectively over a wider area, thereby increasing bearing capacity and decreasing differential settlement.

The zone of influence created by the geocell is slightly higher than the cell wall height – and applicable to any structural layer. The beam effect was verified by extensive testing at Kansas State University (KSU) and confirmed by unpublished results at the Indian Institute of Technology (ITT) Chennai, India. In fact, unpublished results from KSU show that the structural contribution of Neoweb (20 cm wide by 10 cm high geocell) is equivalent to three geogrid layers.



Vertical Ressure Isobars under Uniformly Loaded Circular Area

Comparison of Geogrid vs Neoweb Confinement Zone

SIF - Subgrade Improvement Factor

A different method for calculating the Neoweb contribution to structural pavement reinforcement over soft soils is the SIF. Based on empirical studies, the SIF design method was developed by PRS to quantify the benefits of using Neoweb geocells in the subbase layer, and tested and validated by IIT, India. Based on standard quality infill, an effective subgrade CBR value can be calculated according to the following table:

SIF is based on widely-used conventional design for geosynthetic reinforcement. The Neoweb product and SIF design method recently received accreditation by the Indian Road Congress (IRC), the official transportation body of India. The advantage of the SIF method is that it can be easily used within the AASHTO design methodology.

	Traffic Intensity AASHTO 1 – sporadic, $0.0x10^4 \div 3.8x10^4$ 7- very heavy $1.5x10^7 \div 8.0x10^7$						
	1	2	3	4	5	6	7
In Situ CBR (%)	Neoweb SIF Value						
< 1.0	3.1	3.1	3.1	3.0	3.0	3.0	2.8
2.0	3.0	3.0	3.0	2.9	2.9	2.8	2.7
3.0	2.8	2.8	2.9	2.7	2.7	2.6	2.5
4.0	2.6	2.6	2.6	2.5	2.5	2.4	2.3
5.0	2.2	2.3	2.3	2.1	2.1	2.1	2.0
6.0	2.0						
7.0	1.7						
8.0	1.5						

Subgrade Improvement Factor (SIF) as Function of Traffic Intensity

Resilient Modulus

Another conventional design method utilized is to analyze the resilient modulus of each structural layer separately. The structural strength is the accumulated sum of each layer. This design method is common and straightforward.

Confinement increases the resilient modulus values of granular materials used in pavement structures and especially inferior fill, such as fine granular soils and recycled materials with high plasticity such as Reclaimed Asphalt Pavements (RAP). When using Neoweb, the resilient modulus of a reinforced layer increases. Although these values are obtained empirically, a large R&D project to quantify and publish the values for each material is currently underway by experts at leading universities.

Accreditation

Neoloy Neoweb has been subject to in-situ testing and evaluation by leading researchers, universities, geotechnical institutes and government transportation agencies (road and rail) around the world, for example:

- U.S .state department of transportation (DOTs - Kansas, Iowa, Nebraska, Missouri and New York)
- KOAC-NPC road standards institute in Holland
- RZD Russian National Railways
- Gazprom® energy corporation
- Additional national road and rail certification boards in the US, Great Britain, India, Israel, South Africa and Poland.

These evaluations confirm that Neoweb is a “disruptive technology” when compared to the limited 2D confinement zone of geogrids (requiring more expensive graded aggregates) or HDPE geocells that lack the long-term load support stiffness for infrastructure project life-cycles.

The Need for a Better Polymeric Material

Time Dimension

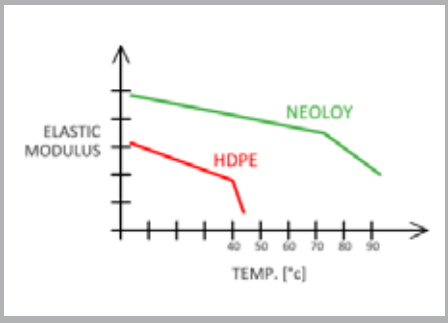
The widespread acceptance of geocells for reinforcement in load support applications is dependent on its dimensional stability over time. Preservation of cell geometry in all three planes is essential to preserve the stiffness, beam effect and resilient modulus to maintain soil confinement and compaction. Even minimal expansion of the cell geometry under dynamic loading, will dramatically weaken the pavement structure. Long-term dimensional stability under thermal cycling over the design life of the project is mission critical.

The time dimension is based on several factors:

- Resistance to permanent plastic deformation over time (creep)
- Dimensional stability under thermal cycling: thermal expansion coefficient vs. the loss of strength and stiffness at high temperatures.
- Resistance to environmental influences, oxidation and UV degradation over time.

Although HDPE is the conventional polymer in geocells, lab test and field trials have demonstrated that HDPE based geocells deform plastically over time and are dramatically impaired by high temperatures. These properties limit HDPE to short-term use and rendr it unsuitable for long-term structural applications. The following polymers are typically used for geocells:

- HDPE – lacks stiffness; low dimension stability and loses its strength above 55°C, limiting its long-term use.
- Polypropylene (PP) – very sensitive to high and low temperatures and UV radiation
- Polyester – lacks elasticity for cellular geometry and is too brittle

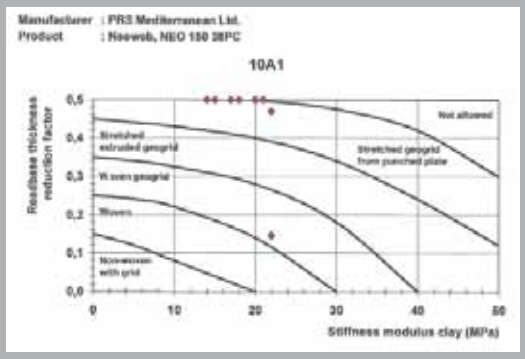


Neoloy vs. HDPE: Change in Elastic Modulus due to Temperature Range

Neoweb Geogrid Trial in Road Base

The enhanced stiffness provided by Neoweb reinforcement enables a significant reduction in the thickness of structural pavements, as demonstrated in geosynthetics field trials for load support applications conducted by KOAC-NPC (Netherlands). Neoweb was the only geocell tested (against 7 leading geogrids) and the only one tested with inferior aggregate infill.

The mean road-base thickness reduction factor for a CBR of 1.5 was calculated for all the tested products utilizing the CROW design methodology. The mean (unlimited) reduction factor for Neoloy-based Neoweb was 73%, a result higher than all previously known values for road reinforcement. Even after truncating the range to known values for geogrids (less than 0.5) Neoweb achieved the highest reduction factors.



CROW Road-base Thickness Reduction Factor

Advantages of Neoweb

- Reduces Construction Costs for Paved And Unpaved Roads in Weak Soil.
- Increases Soil Modulus/Bearing Capacity.
- Reduces Aggregate, Structural Pavement and Asphalt Layers' Thickness.
- Retains Cell Wall Stiffness for Project Lifespan
- Maintains Compaction by Eliminating Particle Movement.
- Allows Utilization of Local, Inferior and Recycled Materials for Infill.
- Reduces Long-Term Maintenance Costs.
- Provides Sustainable Solutions with Significant Environmental Benefits.

PRS – Professional Reinforcement Solutions

PRS is the largest producer of three-dimensional cellular confinement systems (geocells) in the world. As a leader in soil confinement and reinforcement technology for over a decade, PRS has developed an advanced generation of Neoweb® geocells. These are based on Neoloy™, a unique polymer technology developed by PRS. Neoloy-based Neoweb offers high level and long-term performance that is aligned to the typical design life requirements of civil engineering projects.

NEOLOY – Breakthrough in Geocell Technology

What is Neoloy

To create a new cellular confinement system that meets the engineering requirements for long-term performance, PRS embarked on an ambitious and intensive five-year R&D program. The result was the synthesis of a completely new material for Neoweb, called Neoloy. Neoloy is a unique polymeric nano-composite alloy based on dimensionally stable polymer nano fibers (polyester or nylon) in a polyolefin matrix.

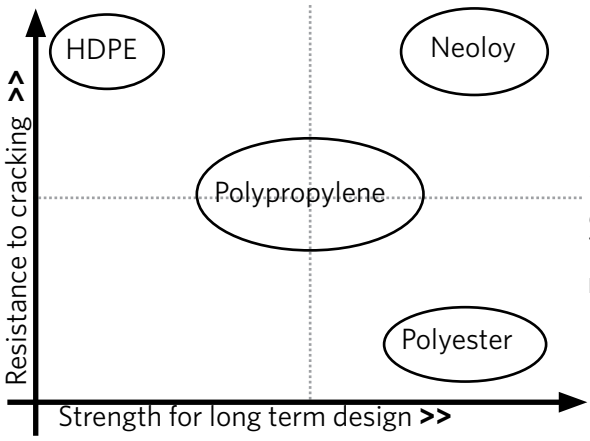
Neoloy polymeric alloys used in Neoweb providing the long term stiffness and dimensional stability required for long-term confinement in earth retention and road and rail pavements applications. Unlike HDPE, Neoweb geocells with Neoloy maintain their engineering properties over time and under elevated temperatures (see illustration).

These properties can be measured by accepted testing procedures and verifiable scientific testing methods. Essentially PRS has added the dimension of time to conventional 3D geometry of geocells to create an entirely new generation geocells: 3D plus design-life time.

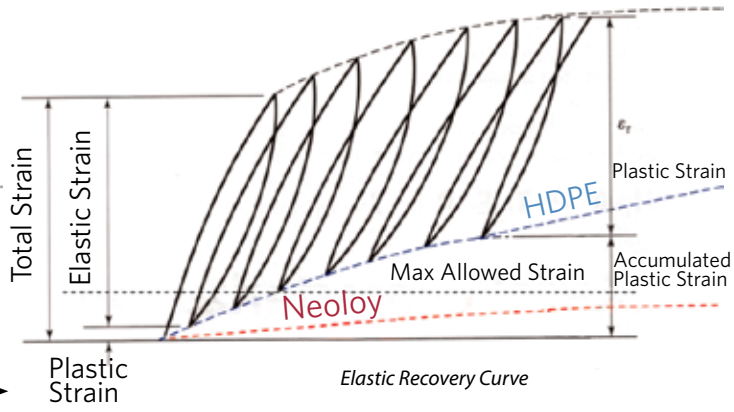
Neoweb based Neoloy geocells offers significant advantages over HDPE-based geocells include:

- Significantly stiffer and stronger
- Very high plastic deformation (creep) resistance
- Much more dimensionally stable, for reliable confinement in wide temperature range
- Far more resistant to oxidation and UV light degradation for very long periods

Neoloy's excellent mechanical, physical and chemical engineering properties extend Neoweb's design life well beyond conventional geocell technology and provide a clear value proposition compared to other geocells, geogrids and other reinforcement geosynthetics.



Mechanical Properties of Different Polymeric Materials



Elastic Recovery Curve

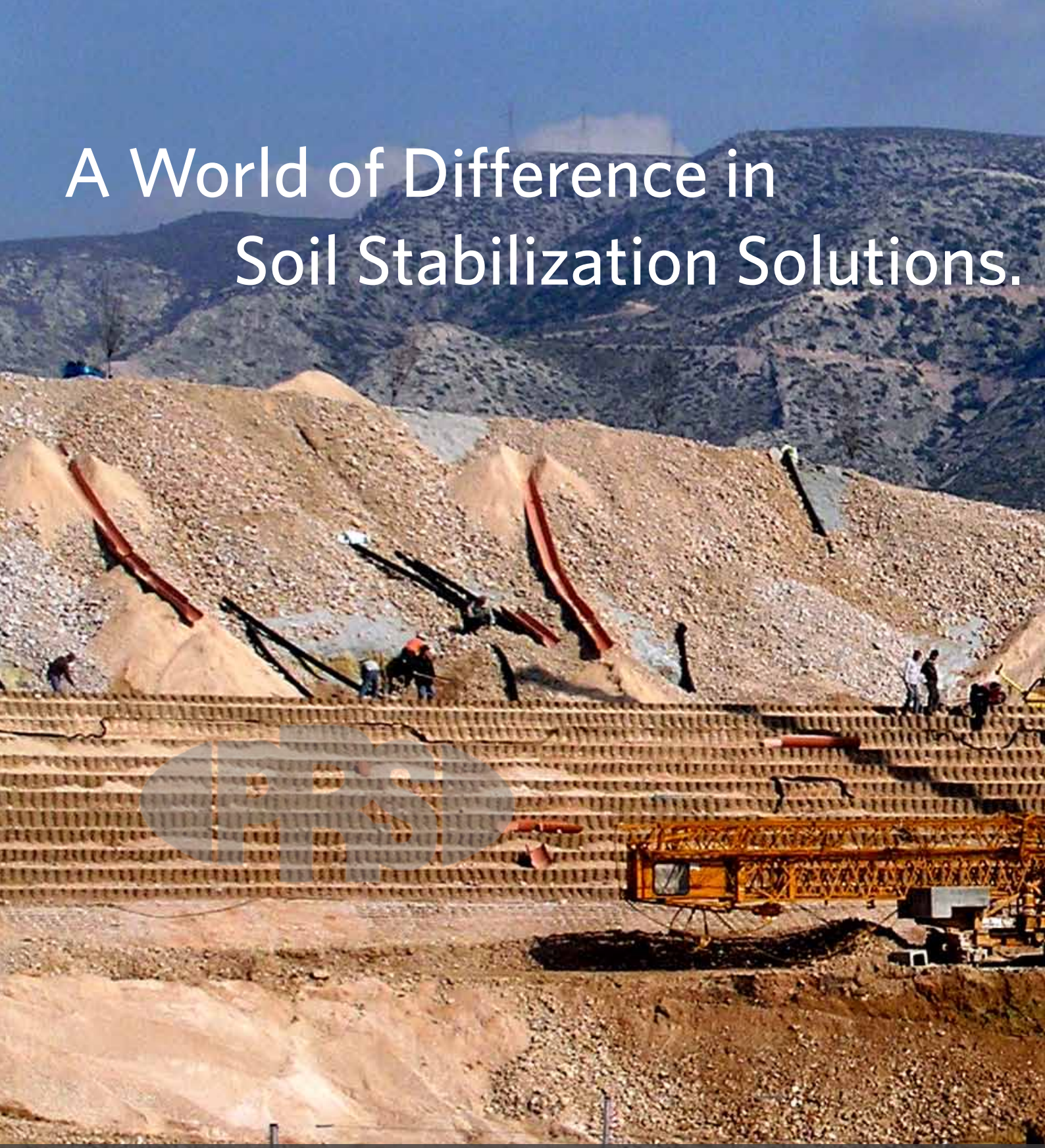
Neoweb Engineering Benefits

- **High pavement thickness reduction factor** – reduce pavement structural layers up to 70%.
- **Improvement of reinforced layer modulus** – increases layer strength by a factor of 3 - 5, or more, depending on infill quality.
- **Utilizes inferior infill material** – local non-cohesive fill, granular soils and recycled material (RAP) can be utilized as part of the pavement structural design.
- **Semi-rigid beam** – distributes loads evenly, increases subgrade bearing capacity by a factor of 3, and reduces vertical subgrade stress up to 50%.
- **High tensile strength** – permanent deformation (including creep) reduction factor of 2.5 as opposed to 6 for geocells made of HDPE, based on 100 year design.

Neoweb Engineering Benefits

- **Confinement maintains compaction** – dramatically minimizes vibration and movement of soil particles and significantly reduces aggregate abrasion and attrition. Result is longer lifespan and reduction of maintenance periods by a factor of up to 3.
- **Unique Neoloy polymer technology** – maintains its engineering design properties and long-term dimensional stability under thermal cycling, static and cyclical loadings.
- **Economic & Environment Sustainability** – less quarry excavation, aggregate hauling, fuel expenditures and carbon pollution.
- **Cost Effective** – lower Initial construction costs + low Total Cost of Ownership due to reduced operating and maintenance costs.
- **Maintenance of engineering characteristics at elevated temperatures** – as opposed to complete loss of polymeric engineering properties of HDPE at 60°C.

A World of Difference in Soil Stabilization Solutions.



LOAD SUPPORT

Durable Roads & Rails

Designed for the challenges of transportation engineering Neoweb meets industry standards for long-term load support in road, rail, multi-modal port and platform applications. It is faster to install, provides higher bearing capacity, extends road life and is more cost-effective than any other ground improvement strategy.

EARTH RETENTION

Long-term Earth Stabilization

Neoweb offers cost-effective mechanically stabilized green wall and earth structures for steep slopes, sharp grade changes, irregular topography, or lack of land. Neoweb retaining walls provide steep vertical earth retention that is structurally stable in compressible and unstable foundation subgrades, even under severe seismic loading.

SLOPE & CHANNEL PROTECTION

Effective Erosion Control

Neoweb provides long-term erosion protection for all types of embankments, slopes and shorelines in civil, infrastructure and environmental projects. Used with topsoil and vegetative cover for natural landscapes, or with hard armor surfacing if exposed to more severe mechanical and hydraulic pressures, Neoweb effective protects and stabilizes soil.

RESERVOIR & LANDFILLS

Reliable Geomembrane Protection

Neoweb protection of containment geomembranes creates protected, impermeable, non-slip and durable impoundment of solid waste, leachate and liquids. Used in applications which require containment, treatment or control of water, leachate and waste, Neoweb from Neoloy is impervious to salinity, corrosion, acidity, sewage and temperature extremes.

The Geocell is at the Center of our Universe

Today's trend in the growing need to use inferior, local or recycled materials and the need to develop marginal lands puts long design-life, three-dimensional cellular confinement systems in an economically essential position.

Our goal is to be the leaders and world champions in providing durable and sustainable solutions for these ever increasing needs world-wide.

About PRS

PRS is the world's leading supplier of cost-effective soil stabilization solutions. Combining unique, proprietary technology with specialized engineering expertise, PRS delivers proven solutions for load support, slope and channel protection, earth retention, reservoir and landfill applications. With a global network of fully owned subsidiaries and independent local distributors, PRS provides a full range of end-to-end support services. Since its establishment in 1996, PRS has implemented thousands of successful projects in over 40 countries worldwide.

xxxxxxxxx

1488CPD0099

Environmentally Aware
PRS Soil Retention

Stabilizing an unstable world!

www.prs-med.com