

The History of Geocells

In the late 1970's Presto co-invented the technology known as cellular confinement with the US Army Corps of Engineers Waterways Experiment Station (WES). The early applications of cellular confinement or geocells consisted primarily of stabilised, expedient sand roads for military vehicles. What many people may not know about the early development of the geocell cellular confinement system is that the material wasn't always black in colour or plastic? In fact, the early testing of a grid confinement system included wax coated craft paper; a plastic drainage pipe matrix fastened with staples; paper-thin, hexagonal glued aluminium; low and medium density recycled materials; pure polyethylene without UV stabilisation; and square cells similar to old fashioned egg carton separators.

The U.S. Army Corps of Engineers contacted Presto Products, a plastics manufacturer, for assistance in developing a stronger grid confinement system that would maintain strength under heavy loads. Working with Steve Webster at the WES Presto's Gary Bach devised a method to weld polyethylene strips to form a cellular structure that became known as "Sandgrid" and was used by the military primarily for road applications.



Side by side cost/performance testing of a plastic geocell (termed "roadbase") and aluminium geocells at The Waterways Experimentation Station, Vicksburg, Miss. Circa 1979.

After testing various blends of resin, High Density Virgin Polyethylene worked best for weld consistency and structural strength. Since early development with the Corps of Engineers, geocells have been further improved for many other soil stabilisation applications, including the rapid construction of fortified walls in the U.S's Middle East combat zones starting with Operation Desert Storm in the early 1990s.

Early Testing & Projects

Camp Blanding Joint Training Centre in Clay County near Stark Florida is the primary military reservation and training base for the Florida State National Guard. In 1982 half a mile of road five metres wide was laid over sand dunes by the Corps of Engineers. The grids were laid by National Guardsmen, filled with sand, and surfaced with a bitumen emulsion spray. The whole road was constructed in twenty-five working hours and proved that the pavement system could be laid in large quantities, quickly, by inexperienced labour to a standard suitable for carrying heavy duty military vehicles.



U.S. Army Corps of Engineers testing Geoweb at Camp Blanding in 1982

Building sand roads with the Geoweb® system was further proven through a U.S. military exercise known as JLOTS II (Joint Logistics Over-The-Shore) conducted by the WES. Conducted at Fort Storey Virginia in 1983 this exercise constructed sand roads using the Geoweb system and applied thousands of traffic cycles by 100 rubber-tired military vehicles of various axle loadings. This was repeated seven times with no noticeable signs of distress.



Geoweb being laid at JLOTS II in 1983

A second phase of trafficking was initiated, again in 1983, over the same length of geocell. Hovercraft transported 100 unladen 20ft containers from a berthed vessel to shore. The crane used for unloading the hovercraft weighed in excess of 150 tonnes, and travelled along the road twice without distress to the surface. A third phase was then carried out which repeated the first.



Algerian Sahara Desert



An American oil company wanted to access four drilling sites located 800 kilometres south of the Mediterranean Sea coast and 160 kilometres from the nearest village. Transporting both construction equipment and suitable building materials would be difficult and expensive. Asphalt roads were unacceptable because of the high costs associated with mobilisation to these remote locations and local rates of installation. In the desert sand, rubber tired vehicles became bogged down since the sand alone offered little support. Considering the task, the oil company decided to build a test road with the sand filled Geoweb system.

One-thousand additional traffic passes were made using 80 ton trucks. Total traffic count was 5,000 passes with no deterioration in the performance of the road. Following the test, additional geocell sections were ordered to build a 15 Kilometre road to access the first drilling site. After the Geoweb system was installed and filled with the local sand using a front-end loader, the

system was tested using 40 ton and 80 ton gross weight trucks. The first 4000 passes of traffic were applied by a 40 ton Halliburton truck. The road performed very well with sustained traffic speeds of 35 mph. This was excellent considering the conditions.

Permafrost Regions



The Geoweb system is weather resistant and can be installed in virtually any weather condition, even when the ground is frozen or rain is falling. With the high transport costs in Alaska using the Geoweb system to contain lower quality infill materials reduced the requirement for high grade crushed rock in road construction. In 1982 the Geoweb system was used to stabilise sand and pea gravel to form Fire Station ramps at Atqasuk, Point Hope and Kaktovik. These ramps provided reliable access for 2000 and 3000 gallon tanker trucks over soils which typically possess moisture content in excess of 50%

during the thaw season. It was subsequently used for stabilising other village roads.

Patents

A number of patents were awarded to Presto Products from 1982 to 1995 culminating in US 6296924, which addressed "the need to effectively provide an improved cellular web structure that increases the interface friction angle in construction materials such as stone." The patent abstract stated: "The present invention relates to a reinforced cell structure for confinement of material. Specifically, the present invention relates to a cell web material which has apertures that increase the load bearing capacity by improving the interface frictional angle." This marked the arrival of commercial a Geoweb cellular confinement system with all the technical advantages that continue to mark it out from the numerous copy products that have subsequently appeared.

Further patents were granted for related products including the ATRA® Key, a turn-key device designed to save installation time and cost on sites and eliminate the problems associated with stapling panels. With one easy turn, ATRA keys are easier and faster than using staples, allowing Geoweb panels to be connected nearly three times faster. They are also three times stronger than staples, giving a more secure and longer term load transfer connection. ATRA® Tendon Clips are load transfer devices that transfer slope gravity forces from the cell wall to tendons running from top to bottom of a slope.



Atra Tendon Clip



Atra Key

Gary Bach

One of the fathers of geosynthetic technology development, Gary Bach retired from Presto Geosystems after 37 years in 2014. Gary was the co-inventor of geocells with the US Army Corps of Engineers. He fused the Corp's concept of three-dimensional grid confinement with his polymer expertise, subsequently devising a strong cellular confinement system made by welding strips of high strength polymer blend materials to form geocell sections. The very first honeycomb like sections were born from a welder designed and crafted by Gary. The early geocell applications were focused primarily on meeting the military's need for military vehicle access across beach sand and artillery bunkers. Shortly after, Presto Geosystems expanded into other areas and introduced cellular confinement to the world's commercial market for soil stabilization applications including slope, channel and shoreline protection and vegetated retaining walls.



In Algeria, Gary (second from right) and his sand road installation

Over the years, Gary was at the forefront of advancements in the geocell technology, including textured and perforated cells for better infill interlock and drainage, and numerous accessory inventions to improve design strength and to speed installation. Over the years, his travel to support projects took him to some of the world's most interesting and remote places. Today geocells are accepted as a standard category of

geosynthetics. Wherever soil stability challenges exist, the geocell finds its place as an economical, fast-to-deploy solution. Gary led the Presto Geosystems business with exemplary business ethics, integrity, honesty and long-lasting relationships. Erosion Control professional Marc S. Theisen said on his retirement: "I remember the early days when we were introducing those "honeycombs" for a variety of new applications. Although the geocells had great potential, it took the perseverance of Gary and others to create textured, earth coloured and more porous product offerings. So much progress over the years."

Geoweb goes International

The benefits of the Geoweb system were quickly recognised around the world.

Largest Retaining Walls in Korea

Perched on top of a mountainous area in Kangwon-do, Korea, the Phoenix Park Resort is protected from the effects of erosion by a system of walls including the largest retaining wall in Korea. The use of this earth retention system at the Phoenix Park Resort met the key criteria by providing: 1) a very steep or nearly vertical surface which minimizes erosion and remains structurally stable under its own self weight and known externally imposed loads, 2) natural vegetative cover by filling outer cells of the stacked Geoweb sections with topsoil, giving the wall the ability to blend in naturally with the Resorts environment, 3) complete construction, in only two months, this provided the cost savings needed to keep the project within budget. The largest structure measures 200 metres in length, with heights varying from 6m to 14 m. People who visit the resort are astounded by the size of the wall structure and impressed with how well the system blends with the surrounding natural area.



Avalanche Protection System - Iceland.

Siglufjörður, a town resting under steep mountainsides, has the highest percentage of snowfall in Iceland, and is prone to avalanches. Historically, avalanches have posed a threat to the people of Iceland. In 1995, two avalanches killed 34 people in Northwest Iceland. The Geoweb earth retention system was selected for the avalanche barrier system by VSO Consulting of Iceland, an engineering design firm. "The plan was to use a concrete retaining wall, but then VSO decided to look for something more environmentally and aesthetically suited for the area, since the barrier would be located on the slopes facing houses in the village," . " Key criteria for selecting Geoweb earth retention systems include the project site soil conditions, availability of suitable backfill materials, project economics and the desired aesthetics of the completed site. The avalanche protector, which was completed in December 2005, involved installing five Geoweb barrier systems, each more than one mile long and 15 to 20 feet high. "The Geoweb system provides a sustainable solution to soil stabilization problems. Manufactured from polyethylene, the system's outer cells, when filled with site topsoil, provide an ideal environment to support native vegetation. In addition, Geoweb material is much faster to install than comparable earth retention systems, such as concrete."

Geoweb in Britain



Early sites in the U.K. included tracks at Stangate Landfill site in Kent, sub base areas on reclaimed land at Portsmouth continental ferry terminal, and sub base areas filled with surplus beach sand at

Blyth Harbour. Since then Geoweb has been used on many hundreds of sites. These range from military roads on Salisbury Plain (left) to an almost unique U.K application – Tree Root Protection. Arboricultural Practice Note 12 published by The Arboricultural Advisory and Information Service describes the use of cellular confinement systems as a three dimensional load spreader, providing a no dig solution to

building paths and roads around trees without disturbing the delicate root systems. Supported by the controls of BS 5837:2012 "Trees in relation to design, demolition and construction" this gives a high level of protection the country's heritage of ancient and culturally significant trees. Greenfix the sole Geoweb distributor in the U.K, is unique in providing site specific solutions calculated on both CBR & Bulk Density for true tree root protection. Finding affordable and cost effective solutions to Tree Root Protection challenges is a major issue for town planners and local authorities, Geoweb leads the way in Tree Root Protection specification.



As the originators of cellular confinement Presto continue to manufacture in the USA from high-quality, high-strength polyethylene so quality and performance are always dependable. The Geoweb manufacturing process is certified by BSI (British Standards Institution) to ISO 9001:2008. It is manufactured from High Density Polyethylene with a patented textured surface and perforated walls. Presto offers it's free, MSE design software for Geoweb geocell wall applications. The software creates vegetated and non-vegetated MSE designs using the Geoweb® system for reinforced slopes, and for gravity and geogrid-reinforced walls Presto Geosystems also offers their easy-to-use SPECMaker® Tool which enables clients to create custom Geoweb specifications based on their exact project design. Presto Geosystems also offers their easy-to-use SPECMaker® Tool which enables clients to create custom Geoweb specifications based on their exact project design Daniel Barney, sales director with U.K. distributor Greenfix said; "Geoweb is the market leader in providing innovative site specific solution to slopes, earth retention and load support applications. In talking to clients in many different areas of construction Geoweb can offer a cost effective solution that will stand the test of time". With 40 years of development behind it Geoweb is set to meet the challenges presented by the changing ground and climate conditions of the 21st Century.



Greenfix is the leading designer and supplier of soil stabilisation and erosion control systems in the UK. In association with Soiltec® in Germany and Presto Geosystems® in the USA, Greenfix has developed a comprehensive range of products and systems to combat the complex and diverse problems associated with erosion control and soil stabilisation. At Greenfix we are committed to delivering the highest quality service to all our customers, offering help from the early design stages through to guidance at installation.

Greenfix is the UK stockist of the Presto Geoweb® cellular confinement system, used extensively for a wide variety of solutions to issues including tree root protection, load support, slope and channel protection, earth retention and flood defence.

Greenfix erosion control products vary from biodegradable pre-seeded blankets and permanent turf reinforcement mats (TRM'S) to un-seeded blankets and meshes in biodegradable and permanent materials. Our product range also extends to grass seed, mulch mats, root barriers, silt control and much more. To view the full range please visit our product pages.