CIVIL ENGINEERING SOLUTIONS

TENAX®


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TENAX SOLUTIONS FOR CIVIL ENGINEERING APPLICATIONS

For all civil engineering projects, an engineer must account for two important factors: site soil properties and water. The soil provides the essential material in all types of soil structures, and the presence of water is one of the most detrimental factors to any civil engineering structures. When a civil engineering structure is constructed on soft or saturated soils, the soils' lack of bearing capacity can cause catastrophic structural failure, or serviceability problems. For roads, differential settlement due to poor soil conditions and dynamic loadings produce deep rutting thus hazardous traffic conditions. Conventional soil retaining walls are expensive to build, and a soil only slope cannot be built steeper than the soil natural angle of repose. Tenax stabilization and reinforcement geosynthetics provide engineered solutions, thanks to their superior tensile properties and interlocking capacity with various soils.

The detrimental effects of water in soils and related materials are also significant. AASHTO (1993) reports: saturation can reduce the dry modulus of the asphalt by as much as 30 percent or more. Added moisture in unbound aggregate base and subbase is anticipated to result in a loss of stiffness on the order of 50 percent or more. Saturated fine-grain roadbed soil could experience modulus reductions of over 50 percent. If the pavement system is saturated only 10 percent of its life, a pavement section will be serviceable only about 50 percent of its designed performance period. The situation is further exacerbated in northern latitudes where freeze/thaw cycles are expaneded. For soil retaining walls, hydraulic pressure build-up behind the wall face can cause the instability of the entire structure. Tenax high performance drainage products provides an economic alternative to soil drains, thanks to their outstanding drainage capability under various field conditions.

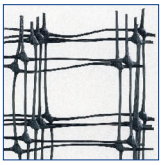
STABILIZATION, REINFORCEMENT, SEPARATION & FILTRATION

Geogrids help facilitate the more efficient and predictable stabilization of poor soils for construction projects. Specify Tenax geogrids for design of an embankment over a weak subgrade, a working platform over expansive clays or a foundation requiring extra reinforcement. Geogrid soft soil stabilization techniques provide solutions to conventional techniques such as deep undercutting and chemical stabilization by reducing construction time, costs and difficulties.

In base reinforcement, applications such as paved or unpaved roads, geogrids are used to provide reinforcement and confinement to base course materials. Typically the fill material used in base reinforcement is a quality granular material with specific structural characteristics. This high quality granular fill can also be very expensive. By incorporating Tenax geogrids, the required thickness of the granular fill can be significantly reduced, translating into significant cost savings.

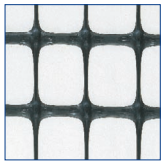
With Tenax geogrids, an effective stress transfer mechanism between the geogrid and surrounding soil is established. Therefore, lateral movement of the base course is prevented and applied loads are distributed to a wider area.

MS MULTILAYER BI-DIRECTIONAL GEOGRIDS



Tenax's MS geogrid has a greater number of tensile elements per unit area while still providing high tensile strength, modulus and appropriate aperture geometry. Tenax MS multi-layer geogrids are more effective than a single layer geogrid to reinforce fine particle size soils. This increased number of tensile elements allows for more effective interaction with a wide range of soils. In addition, the multiple layers of MS geogrids provide an increased cross-sectional thickness, allows for increased separation between the subgrade and fill material.

LBO SAMP BI-DIRECTIONAL GEOGRIDS

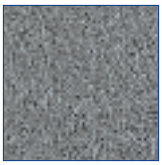


(Not sold in the U.S.A.)
Tenax LBO Samp is specially designed for the stabilization and the reinforcement of soil. The single-layer biaxial grid is produced by a patented extrusion method and further biaxially drawn to increase tensile properties. Its high tensile strength makes it ideal in applications where granular soil is present. Tenax LBO Samp's unique abilitly to interlock aggregate within its apertures allows for the effective confinement and reinforcement of the soil. Tenax LBO Samp is also used in reinforcement of small slopes or as a secondary reinforcement in conjunction with Tenax TT Samp Uniaxial geogrids.

TT SAMP UNI-DIRECTIONAL GRID

(Not sold in the U.S.A.)
Tenax TT Samp geogrids are engineered for all types of reinforced soil structures such as retaining walls, steep slopes and embankments. The geogrids are two-dimensional structures produced from high-density polyethylene using an extrusion process followed by mono-directional stretching. This monolithic structure has a uniform distribution of long, elliptical apertures resulting in a high tensile strength and high tensile modulus in the machine roll direction. The compaction of granular material from the backfill over the geogrid layer creates an interlocking action between the aggregate and the geogrid. This action provides an optimal interlocking system enabling the geogrid to resist horizontal shear from the fill and mobilize the maximum bearing capacity of the underlying subsoil. Tenax TT Samp increases the soil's resistance to static and dynamic loads.

ULTRA-VERA NONWOVEN GEOTEXTILE



All geotextiles lose strength due to ultraviolet light exposure. It is not uncommon for the geotextiles used at construction sites to remain exposed to sunlight for extended periods of time.
To alleviate concern for UV exposure, Tenax ultra-vera polypropylene geotextiles are UV stabilized using Hindered Amine Light stabilizers. Our high UV resistance geotextile can meet or exceed 95% strength retention for at least 500 hours and 90% for 1000 hours.

Hindered Amine Light Stabilizers (HALS) are the most effective of the light stabilizers for polypropylene. HALS work by retarding the photodegradation of plastics by decomposing the radical intermediates formed during the degradation process. Tenax uses a continuous filament process, which allows for the control of the extruded polymer formulation by adding increased stabilizers during processing. The UV resistance can be increased far beyond that of other geotextiles and therefore extend the time Tenax geotextiles may be left uncovered without damage or degradation.

Texas DOT State Highway 73, MS 220 geogrid for subgrade stabilization. Nebraska liquid retention pond, MS 500 geogrid for clay stabilization.Tenax TT for retaining wall construction. Pennsylvania Employee Credit Union Park, MS 330 for base reinforcement

ROADWAY DRAINAGE

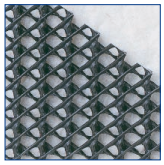
There are three very important components required for a good pavement design: drainage, drainage, drainage. It is a well-known fact that water in pavement systems is one of the principal causes of pavement failure. To prevent pavement failure, the engineer needs to give due consideration for adequate drainage design.

One solution for drainage incorporates a free-draining base aggregate into the pavement system, but this typically requires asphaltic or cement stabilization binder to facilitate construction. In addition, a granular layer or geotextile filter is required to prevent migration of subgrade fines into the open-graded base.

Another drainage issue is damage caused by frost heave and subsequent thaw. Among the damage caused by frost heave is the cost of repair and maintenance, possible restrictions on vehicle weight, and even complete closure of roadways. The traditional geotechnical solution has always been to remove the frost susceptible soils down to frost depth and replace them with non-frost susceptible material. This requires extensive excavation and added cost when suitable structural fill is not readily available.

Standing water in a highway during construction. Tenax Roadrain for pavement Drainage on VA Route 58, Virginia.

ROADRAIN FOR PAVEMENT SUBSURFACE DRAINAGE



The synthetic aggregate solution–Roadrain is the solution to problems associated with roadway drainage. By providing excellent drainage, Roadrain greatly extends the life of roads and reduces maintenance costs. Plus, Roadrain is easy to install and readily available.

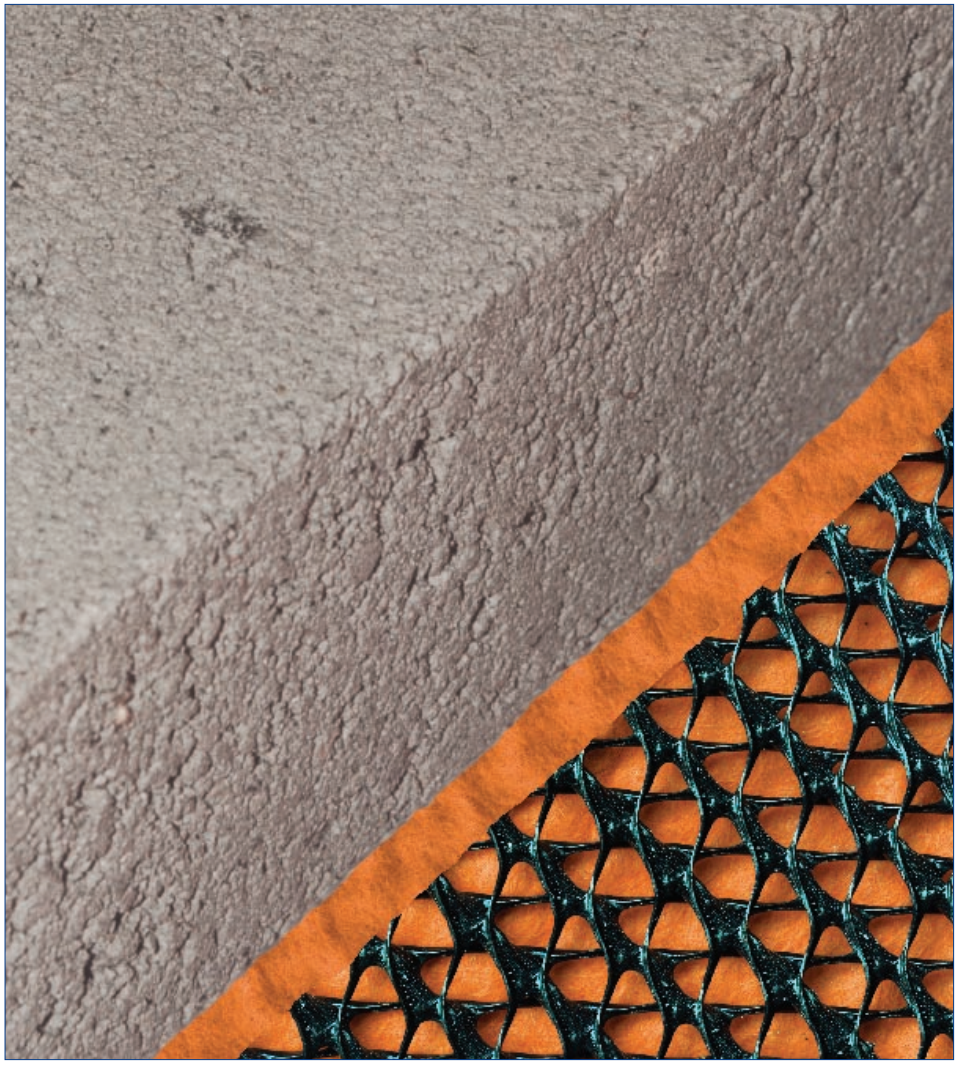
Roadrain's engineered solution to improve drainage and/or reduce frost heave potential incorporates a compressive resistant, void-maintaining drainage system into the pavement structure. Roadrain has great compressive stiffness to support traffic, rapid fluid transmission characteristics equivalent to free-draining base, significant air void to provide a capillary break. Roadrain also possesses high tensile strength allowing it to provide reinforcement and subgrade restraint in addition to drainage and separation.

Maine U.S. Route 1, Roadrain for subsurface drainage. MN Steele County Highway 35, Roadrain for capillary break layer. Texas, Austin Southwest Parkway Roadrain for seepage water interception.

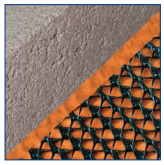
CONCRETE SLAB BEDDING

Concrete is made up of 2 major components: cement paste (Portland cement + water) and aggregate (sand + gravel or crushed stone). When concrete starts to harden, it contains a considerable amount of free-water that has not combined chemically with the cement. When this free water evaporates, concrete shrinks. To minimize shrinkage, the total amount of water in the mix must be reduced.

On the other hand, concrete slabs do not shrink uniformly from top to bottom; the top dries out more rapidly than the bottom, particularly in hot climates and during summer months, and tends to shrink more. As a result, an initially uniform slab becomes shorter at the top than at the bottom, and tends to dish upward around the periphery. This phenomenon is called curling. Curling includes tensile stresses in the top part of the slab, as the slab ends tend to bend downwards under the self-weight and traffic loading, and if these stresses exceed the tensile strength of the concrete, cracks will appear.



ROCK-IN-ROLL



Tenax Rock-in-Roll is a high tensile, low compressibility Void-Maintaining structure, which replaces free-draining aggregate underneath concrete slabs. Rock-in-Roll is comprised of top and bottom layers of geotextile sandwiched around a center Void-Maintaining geonet. The Void-Maintaining geonet in this structure is composed of top and bottom horizontal ribs separated by strong vertical ribs.

Rock-in-Roll is hydraulically equivalent to 4 inches of open-graded/free-drainable base course. When compared to natural drainage material, Rock-in-Roll maintains its performance criteria as a controlled manufactured product, under the construction loads and conditions. On the contrary, the natural drainage material is exposed to the contamination of finer soil during or after construction. Rock-in-Roll helps the concrete slab to reach the commonly required water-vapor emission rate in a shorter period of time, by providing a second surface for water to drain. Rock-in-Roll causes no negative effects on the compressive strength of concrete at any age.

Rock-in-Roll provides a supportive layer underneath the floor slab to bridge soft spots, enabling the slab to perform better by reducing the cracks and tensile stresses resulting from differential settlement. In addition, Rock-in-Roll also provides a capillary break to prevent the water from contacting the floor slabs.

Rock-in-Roll under sidewalk in Florida.

EROSION CONTROL

Local hydrological, biological and geotechnical parameters all play key roles in the complex phenomena of erosion. However, the magnitude of erosion is heavily dependent on the synergistic effects of two main mechanisms:

- detachment and movement of soil particles due to raindrop impact, and
- detachment and transport of soil particles due to surface runoff.

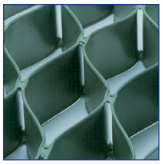
Among the above, runoff, in particular, caused by high-volume and high-velocity storm waters can erode soil within open channels, drainage ditches, swales, and on steep exposed slopes, increasing the transport of sediments into receiving waters.

Erosion control methods vary in their effectiveness, cost and appearance. Tenax geosynthetics for erosion control offer technically sound, environmentally sensitive, yet economical solutions.

MULTIMAT FOR TURF REINFORCEMENT

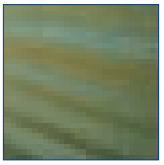
The three-dimensional "gripping" geomats are designed for the protection and planting of slopes subjected to surface erosion whenever a suitable vegetative substrate soil exists. The process of molecular stretching enhances the mechanical properties of the base polymer providing a high tensile strength. Multimat is composed of two layers of geogrids placed above and below a single central layer, mechanically folded to give thickness and three-dimensionality to the geomat. Multimat is protected against UV degradation by the addition of carbon black during the manufacturing process. Typical applications are for the protection of roadway ditches, steep slopes, storm and irrigation channels and lakeside banks.

TENWEB FOR SOIL CELLULAR CONFINEMENT



Tenweb geocells are honeycomb-shaped structures made by the continuous extrusion of polyethylene and without welding. The structure opens like an accordion and can be transported and stored with minimal space and opened during installation, creating a series of completely interconnected cells. The structure's junctions have a central opening through which water can pass so that effectively, all the cells are hydraulically interconnected ensuring that organic material receives moisture for rapid growth. Tenweb is ideal for erosion control where the ground on slopes is dry and rocky due to lack of organic material. Under these conditions Tenweb provides an adequate depth of soil to allow for growth of vegetation.

SILT FENCE FOR SEDIMENT CONTROL



Pre-assembled Silt Fence is the ideal barrier for sediment control around construction sites or wherever there is bare or disturbed earth. The woven geotextile used on Silt Fence is designed to filter out sediment from construction site run-off, yet allows clean water to pass through. The use of Silt Fence helps to ensure a free-draining, environmentally safe site. Silt Fence is Pre-assembled with hardwood stakes securely attached at 10 foot intervals and packaged in 100 linear foot rolls.

Tenax Multimat 100 TRM for park farm drainage, UK. Tenax Tenweb 300 cellular confinement system for slope erosion control, New Mexico. Tenax Silt Fence for sediment control, Maryland.

ABOUT TENAX

Established in Italy in 1960 as a company specializing in the extrusion of thermoplastic polymers, TENAX has been the rising star with constant growth in production. Its corporate and organizational growth now places it as an International Group with a turnover of around $100 million of which 40% comes from outside the European Union. TENAX has 500 staff working in production units, technical and sales departments and distribution centers which are responsible for contacts within the various markets.

Its detailed attention to the development of markets has led the TENAX Group to progressively extend its organization, favoring the establishment of numerous specialized production units. After the establishment of the original Italian headquarters in Viganò in the province of Lecco, the first company specializing in agricultural products was established in the province of Rieti, followed by a large production centers in Maryland and Alabama in the USA. A further seven subsidiaries located in strategic countries throughout the world complete this multi-national organization. The subsidiaries act as receiving centers for the geographical area under their responsibility in order to implement the Group's 'know how' there and from where they benefit from operational autonomy for planning their development.

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