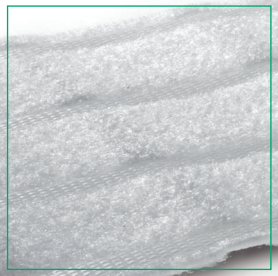
Advantages of PET/PP Combigrid®

- Reinforcement/Stabilisation, filtration, separation and drainage in just one product, reducing aggregate thickness
- Firmly bonded composite product
- Very high strength at low strains
- Immediate interlocking with cover aggregate
- High resistance against installation damage
- Nonwoven geotextile firmly bonded between uniformly extruded PP or PET bars
- High resistance against biological and chemical degradation
- 4.75m wide rolls
- Quick and easy to install
- ISO 9001 certified
- CE marked
- Very high radial secant stiffness values



NAUE

Combigrid®

Combigrid® geogrids are the next generation of geogrids produced with state of the art manufacturing technology, unlike any other geogrid on the marketplace today. The reinforcement element is a highly oriented polypropylene or polyester bar that is uniformly extruded and drawn to achieve a high modulus and strength at low elongations.

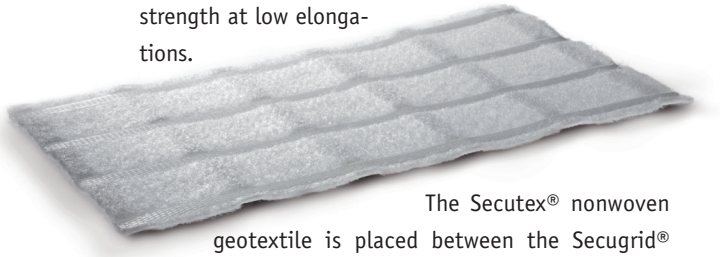


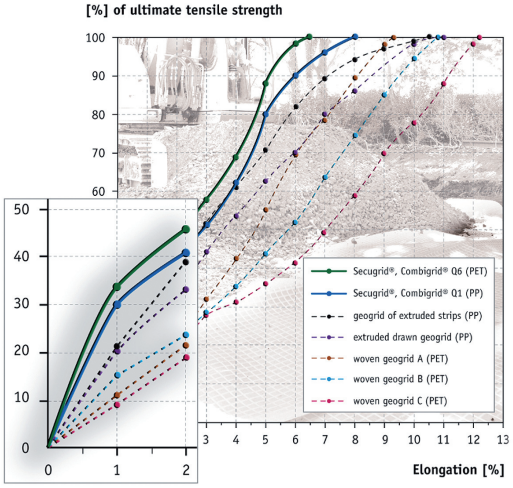
Figure 1
Combigrid®

The Secutex® nonwoven geotextile is placed between the Secugrid® bars during the manufacturing process and is firmly bonded between the reinforcement bars with the NAUE patented welding technology to provide a structurally sound and stable geogrid. Combigrid® geogrids are mainly used in conjunction with soft and low CBR soils where soil reinforcement in combination with separation and filtration is needed, such as in base reinforcement, embankment reinforcement and pile cap platforms.

Advantage: Stress/strain behaviour

Geogrid composites like Combigrid® are used wherever a high strength is required at low elongation. The stress/strain behaviour (also known as strength/elongation) of the geogrid is important when selecting which type of geogrid is to be used or specified. Geogrids will typically have a maximum elongation at break of 6% to 15%. However, the internal angle of friction of medium to densely compacted soils, in realistic design conditions, is reduced when the soil is subjected to an elongation of less than 2%.

Figure 2
Stress/strain curves of Combigrid® and selected geogrids. Enhanced view outlines realistic working strains (< 2% elongation)



It is necessary to align the stress/strain behaviour of the installed geogrid to the elongation behaviour of the soil.

The performance of the geogrid at a stress/strain ratio in the range of 2% is therefore important and here Combigrid® shows its strength. Combigrid® has excellent tensile strengths at low elongations (figure 2) and demonstrates its advantages in the critical required elongation ranges.

Advantage: Soil separation

The three dimensional fibre matrix of the needle-punched Secutex® nonwoven, that is firmly secured between the Secugrid® bars during the manufacturing process, acts as a separation layer between different grain size soils and ensures long-term separation and filter stability. Such a separation layer is typically recommended in base course applications for subsoils with a CBR less than 3% or in applications where fines should be prevented from moving into the reinforced aggregate above.

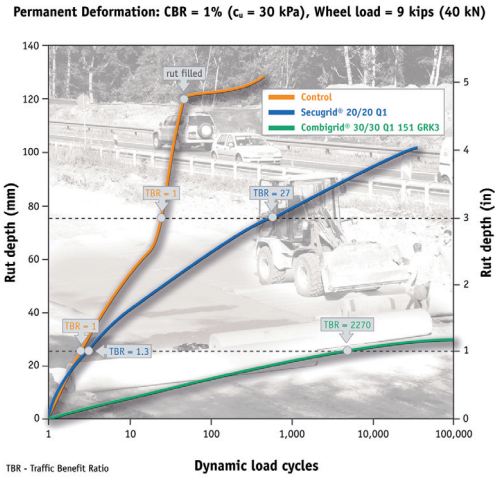


Figure 3
Combigrid® and Secugrid® traffic benefit ratio over a very weak subsoil, compared to an unreinforced design in a simulating test

Tests in the U.S. to simulate the traffic passages on an unreinforced base course resulted in 3inch (75mm) deep traffic ruts after 20 load cycles, and it took 540 load cycles when geogrid reinforcement (Secugrid® 20/20 Q1) was used. However, when Combigrid® (see picture) was used, the corresponding traffic rut depth was not reached even after 100,000(!) load cycles. Using a composite product of geogrids with a nonwoven geotextile firmly bonded between the long and cross bars in the boundary layer to less-portative, soft subsoils worked really well. Combigrid® - not just a geogrid - is the solution for all infrastructure projects to be carried out on less-portative subsoil.

APPLICATION

BUILDING THE PACIFIC HIGHWAY WITH NAUE COMBIGRID®

Australia's Pacific Highway connects the major metropolitan areas of Sydney and Brisbane. A major construction phase along the route has involved the Stewarts River Bridge project, which is part of the Coopernook to Herons Creek upgrade. But like many projects along this vital highway, the subgrade conditions (soft clay) complicated the work. For the Stewarts River Bridge project, the subgrade problem was actually discovered by accident: a piling rig could not be situated safely on site - not without subgrade improvement.

Thiess Contractors needed to support a Bauer BG28 piling rig, which has a loading pressure of approximately 167kPa while travelling and 317kPa when extracting piles. To support this extremely heavy equipment, the site design adopted a conservative subbase CBR of 1%. Accommodating such a conservative design was necessary, but it initially seemed like it would be almost prohibitively expensive. Then NAUE entered the picture. Working with its Australian distribution partner Global Synthetics, NAUE presented an economical solution for stabilising the piling rig platform on the site's weak soils: Combigrid®.

Figure 4 Combigrid® unrolled and covered with topsoil

The selection of Combigrid® proved to be the difference at Stewarts River, allowing not only the construction but preserving the project's cost goals. Utilising a factor of safety of 2.5 for all loading conditions, a 500mm well-graded gravel base course was placed over Combigrid® 40/40 Q1 151 GRK 3 (40kN/m strength @ 8% peak strain, 16kN/m @ 2% working strain). This included a 300mm-thick initial lift layer of clean rockfill base course over the Combigrid® layer with its 200g/m² nonwoven geotextile layer (firmly bonded between the reinforcing bars) and 200mm of road base gravel. A maximum 2% fall was adopted to allow water runoff and maintain stability.

Additional design elements included a recommended 200mm minimum overlap of Combigrid® on lateral and transverse joints. Being a cohesive subgrade, the Combigrid® prevented the upward migration of fines into the working platform. Combigrid® provided the necessary elastic modulus increase along this stretch of the Pacific Highway, delivering a high load capacity within the working strain of the pavement. In addition, it increased the shear strength of the base course through the Secugrid® geogrid's outstanding resistance to tensile forces. The pavement's ability to tolerate the sustained load of the piling rig, movement of rig, and the fluctuating loads during operation of pile activities increased significantly. Transportation in Australia rolls on.

REINFORCING THE SHIPPING INDUSTRY OF MERSIN, TURKEY

In southern Turkey, the city of Mersin has become an important trade center due to its strategically located port on the Mediterranean Sea. In addition to its key shipping access, Mersin possesses a large amount of land for cargo storage and rail and road access. As such, it has become particularly important for trade with the Middle East and for industrial and agricultural imports and exports.
Significant investment has gone into making Mersin a state-of-the-art port for the eastern Mediterranean region. The city (and province, also known as Mersin) has grown steadily and prospered. But the soils upon which the stability of the container shipping port relies began to destabilize with the port's high-level of use and expansion needs. Deep grooves that had developed were significant enough to impair the safety of container cranes. Differential settlement of topsoil was responsible for the collapse of at least one container pile - a threat to the site's safety and, with the potential loss of goods or storage credibility, the port's economic security. Therefore officials called for the redevelopment of various container terminal sections.

Mersin's railway authorities are responsible for the port's activities, including its redevelopment. Perhaps influenced by the way reinforcement technologies are commonly used in railway construction, the port's reconstruction design team called for base course reinforcement. NAUE Combigrid® was chosen to improve the insufficient bearing capacity of the subgrade.

Figure 5 Unrolling and overlapping of Combigrid® over the soft subgrade

Combigrid® offered a number of advantages. Its composite technology uses three-dimensional needle-punched geotextiles between polypropylene geogrid bars with excellent stress-strain characteristics. This combination of strong geotextile and geogrid materials makes it the right choice for applications that require separation, drainage and reinforcement.

For the Mersin project, a test area was setup using 5,200m² of Combigrid® geogrid. The results supported the design goals and led to the further installation of 34,000m² of Combigrid®.

For the installation to be truly secure, the site's 20-year-old soil cover layer and gravel aggregate needed to be excavated to a depth of 1.4m. A nonwoven geotextile firmly bonded between uniformly extruded geogrid bars, Combigrid® 30/30 201 GRK 3, was placed on this base of soft soil.

Combigrid®, in this application, acts as a separation layer between the base course and the subsoil, so that fines do not mix with the reinforced aggregate. The geogrid reinforces the soil by transferring its stresses and by constraining the lateral movement of base course materials. Granular soils interlock with the geogrid apertures (the openings). The geotextile prevents vertical migration. Combigrid® protects the integrity of the reinforced installation in all directions, thus providing true long-term support. Combigrid® is also easy to install, a characteristic that provides savings in time and labour without sacrificing quality. On the same day of the geogrid installation in Mersin, a 1m layer of well-graded base course material was applied and compacted.

A 0.4m thick cover layer of concrete completed the newly reinforced soil. The profit of the reinforcement with Combigrid® was realized quickly. Soil settlement has not been a problem and shipping activity continues to provide vital economic support and life to the region.

INSTALLATION

Loading of Combigrid®

On-site storage

Installed Combigrid® with overlaps

Cutting of Combigrid®

Placement of min. 200mm aggregate

Soil compaction over Combigrid®

Aggregate interlocking

Final compaction

NAUE GmbH & Co. KG
Gewerbestrasse 2
32339 Espelkamp-Fiestel · Germany
Phone +49 5743 41-0
Fax +49 5743 41-240
E-Mail info@naue.com
Internet www.naue.com

ALPHA PINNACLE
Gabions | Geosynthetics | Permacrib | Rockfall Barrier System
Alpha Pinnacle Sdn Bhd (1108444-U)
Unit No. A-01-01, First Floor, Garden Shoppe @ One City,
Jalan USJ 25/1F, 47650 Subang Jaya, Selangor, Malaysia
Landline : +603 5115 0330 Facsimile : +603 5115 0333
Email : contact@alphapinnacle.com URL : www.alphapinnacle.com

, Combigrid®, Secugrid® and Secutex® are registered trademarks of NAUE GmbH & Co. KG in various countries.
The information contained herein is the best to our knowledge, true and accurate. There is no implied or expressed warranty.
© 2014 by NAUE GmbH & Co. KG, Espelkamp-Fiestel, Germany · All rights reserved. · No. 97 · Status 04.09.2014