

Geosynthetics for Windpark Projects



Secugrid® and Combigrid®

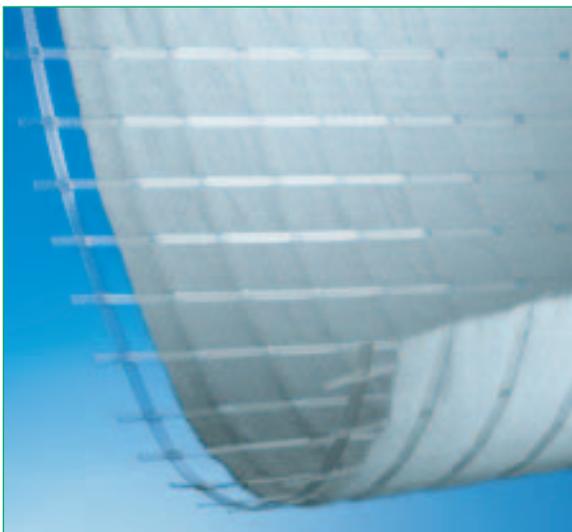
Secugrid® and Combigrid® geogrids are the next generation of geogrids produced with state of the art manufacturing technology, unlike any other geogrid on the marketplace today. The reinforcement element is a highly oriented polypropylene or polyester bar that is uniformly extruded and drawn to achieve a high modulus and strength at low elongations. This is combined with NAUE patented welding technology to provide a structurally sound and stable geogrid. Secugrid® geogrids are used for base reinforcement, mechanically stabilized earth walls (MSE), veneer stabilization, the segmental retaining wall market (SRW), embankment reinforcement and pile cap platforms. Biaxial

Secugrid®



geogrids are primarily used in base reinforcement applications, while the uniaxial geogrids are often used in the other markets. The Combigrid® series incorporate a needle-punched polypropylene or polyester Secutex® nonwoven geotextile separator that is secured firmly between the flat bars on the manufacturing line during the production process.

Combigrid®



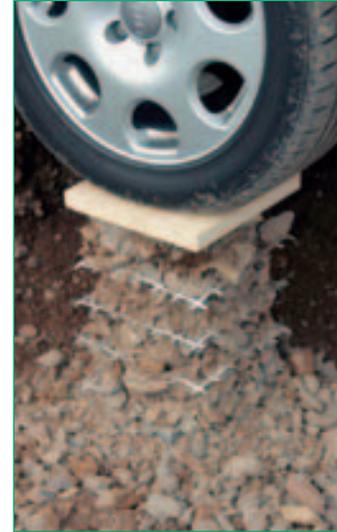
The use of Secugrid® and Combigrid®

Increasing ecological awareness over the last years has resulted in the development of renewable energy resources. One of these, wind energy, has gained huge popularity. New windparks have been built worldwide and many more are being planned to generate electricity from wind sources. As these Wind mills should not disturb the environment or people living near by, windmills are being built in areas with low populations or areas which have low bearing capacity. In order to reach these areas the first task is to build a stable access road.

Typically the base course under these roadways is made of crushed gravel that must provide efficient load distribution of the stresses transferred from traffic. In all cases it is important that the shear strength of the subsoil, which in general can be very low, is exceeded by the base course material. An alternative, cost effective method to achieve a long term safe solution for low strength subsoils is to use Secugrid® or Combigrid® geogrids between the subsoil and the overlying base course.

An additional benefit of this solution is the possible reduction of the overall base course thickness because the Secugrid® and/or Combigrid® geogrid reinforces the base course allowing for uniform stress distribution.

Secugrid® and Combigrid® work by interlocking with the granular or soil material placed over them. The apertures allow for strike-through of the cover soil material which then interlock with the bars (ribs) providing confinement of the overlying granular/soil material due to the stiffness and strength of the bars.

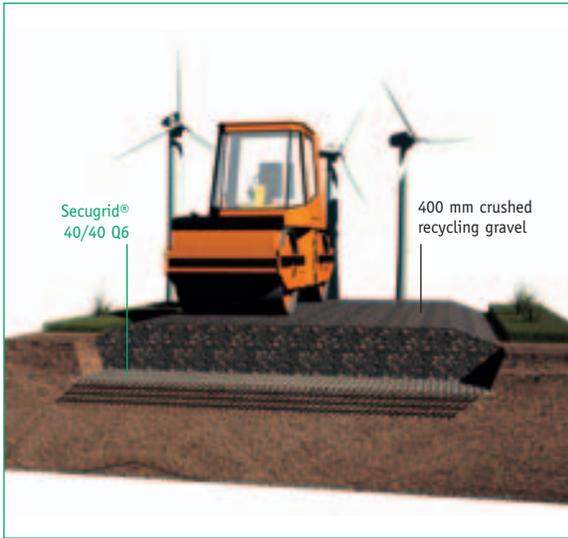


Demonstration of the interlock effect with a car standing on a Secugrid® reinforced gravel column

Project Windpark Oldenswort

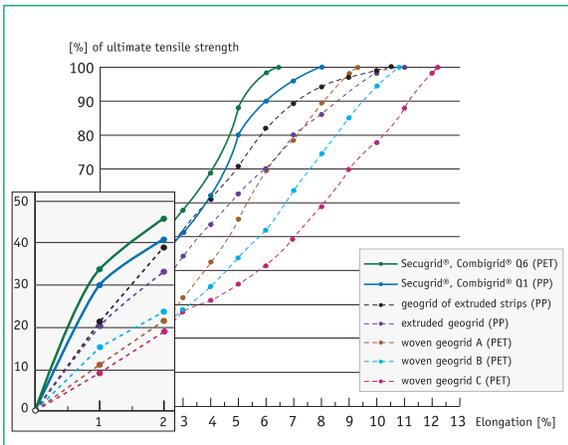
The original concept of this windpark was generated in the 70's and it took over 20 years before the project could get started. In 2001 the project was approved and the authority agreed to allow 4 wind mills to be set up in the designated area. The subsoil conditions in the proposed area were considered to be loamy with low bearing capacity and high moisture content, as is common in this part of North Germany. The measured CBR values were in the range of less than 2 %, but often under 1 %. To avoid too much soil excavation for the access roads, calculations were made that showed it would be sufficient to have 400 mm (16 inch) of crushed recycled gravel overlaying a Secugrid®

Cross-section for the access road in the project Oldenswort



40/40 Q6 geogrid for all access and storage areas. After excavating 400 mm (16 inch) of subsoil, the Secugrid® geogrid was easily placed on the weak subsoil due to its stiffness properties. The crushed recycled gravel was then placed directly on top of Secugrid® and compacted to increase the base course strength. In applications like this, it is important that the selected geogrid have a high strength at low elongation to align the stress/strain behavior of the installed geogrid to the uniaxial elongation

Stress/strain curves of Secugrid® and selected geogrids. Enhanced view outlines realistic working strains ($\leq 2\%$ elongation) in road subbases

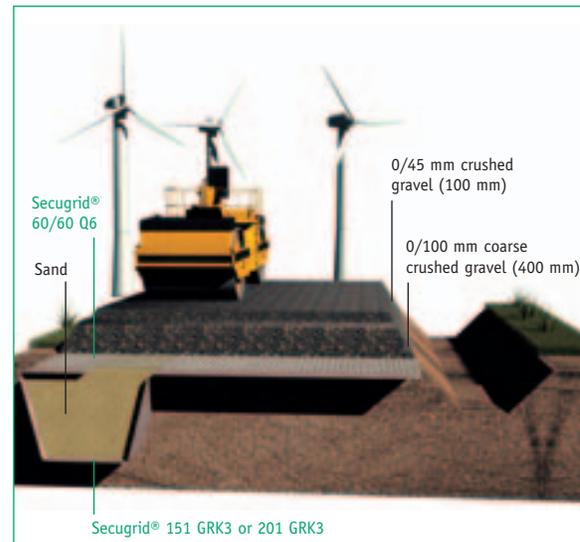


behavior of the soil. This is because the internal angle of friction of medium to densely compacted soils in realistic design conditions is reduced when the soil is subjected to an elongation of less than 2 %. The performance of Secugrid® at a stress/strain ratio in the range of 2 % outperforms most other geogrids and demonstrates its advantages in this critical elongation range. The design also considered the longterm use of the access road for the maintenance of the wind mills.

Project Oldenbroker Field

After the successful installation of Secugrid® in the project Neuhuntendorfer Moor the consultant had similar subsoil conditions in this project. The consultant was able to use the results from the test plots carried out in the previous design for the 12 windmills for the windpark Oldenbroker Field. The subsoil condition of the very soft loam was considered to be under a CBR of 1 % and the groundwater table was just 500 mm (20 inch) under the surface. Drainage ditches at the sides, as well as a collection system under the 4.50 m (15 ft) wide road, were added to the design to allow water to run off to a local retention basin. To prevent any clogging of the collection system the sand layer was wrapped with Secutex® nonwoven geotextiles. The 500 mm (20 inch) thick base course containing crushed gravel was placed over Secugrid® 60/60 Q6 to ensure the longterm stability of the access roads. Over 7,000 m² of Secugrid® and 31,000 m² Secutex® were used for this project.

Cross-section for the access road in the project Oldenbroker Field



Secugrid® 151 GRK3 or 201 GRK3

Installation of Secugrid®



Subgrade preparation



Secugrid® installation

Further projects

Windpark Neuhuntorfer Moor

17,000 m² Secugrid® 30/30 Q6 and 40/40 Q6
40,000 m² Secutex®

Windpark Damme

20,000 m² Secugrid® 40/40 Q6 and 60/60 Q6
10,000 m² Secutex®

Windpark Owschlag

6,000 m² Combigrid® 60/60 Q6 / 251 GRK4

Windpark Uetersen

17,000 m² Secugrid® 30/30 Q6 and 60/60 Q6

Windpark Burgdorf

17,000 m² Secugrid® 30/30 Q6

Windpark Dinklage

28,000 m² Combigrid® 40/40 Q6 / 201 GRK3
and 60/60 / 251 GRK4, 6,000 m² Secutex®

Windpark Hunteburg

19,000 m² Combigrid® 30/30 Q1 / 151 GRK3

Scout moor windfarm

220,000 m² Secugrid® 40/40 Q1, 60/60 Q1,
80/20 R6 and 400/40 R6

Whitelee windfarm

850,000 m² Secugrid® 30/30 Q1 and 40/40 Q1



Placement of cover material



Operating windmills



Access road in use

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

Contact

Distributed by



NAUE, Combigrid®, Secugrid® and Secutex® are registered trademarks of NAUE GmbH & Co. KG.

The information contained herein is the best to our knowledge, true and accurate. There is no implied or expressed warranty.

© 2007 by NAUE GmbH & Co. KG, Espelkamp-Fiestel, Germany · All rights reserved. · No. US-009 · Status 02/2007