Issue 36 · November 2010 · 13th year [20th English translation]

The latest news magazine from the NAUE Group

NAUE NEWS

Confidence in the Future

As 2010 comes to a close, a 30-year era is also coming to an end: at his own request, Prof. Dr.-Ing. Georg Heerten is leaving NAUE operative management. Since this desire of his was made known early on, the company has been able to prepare itself for the necessary change.
Prof. Heerten will continue to advise NAUE as a consulting managing director. In addition, he is dedicating his extraordinary knowledge and experience to future service: at the outset of the German Geotechnical Society's (DGGT) biennial Baugrundtagung (Geotechnical Conference) - the society's main conference - in early November 2010, he was elected DGGT Chairman. In this position he succeeds Prof. Dr.-Ing. E.h. Manfred Nussbaumer and will serve for a four-year term. We wish Prof. Heerten the greatest success in this new endeavour and, additionally, a little more time for his private life, such as sailing on his beloved ship "Blinkfuer."

In addition to the changes in operative management, NAUE will also restructure its sales in 2011. The significant growth in sales personnel, in particular in non-European countries, has necessitated that these regions be reassigned. In the future, there will be six sales areas that will be based on geographical, language and cultural criteria. Dipl.-Ing. Martin Driever, Senior Sales Manager, wants to serve markets and customers even better and further improve the communication between the headquarters in Fiestel and the market regions worldwide. We wish all those involved in this endeavour a successful start!

After announcing so many changes for 2011, what remains to be done is to look back on the year 2010. As already reported in NAUE News 35 (September 2010) under the title "Cold Start", the first half of the year was characterized by the long winter and escalating raw material costs. Business operations normalised during the second half of the year, but the raw material costs remained high. Sales volume and earnings for 2010 will surpass those of the previous year, but we will not quite achieve the goals we had set for ourselves. Therefore, we look forward to the new year with increased motivation. With a committed workforce, new product and application ideas, and confidence that the ecological and economical advantages in geosynthetics will prevail, we move forward.

Did you know...?

NAUE would like to thank Dr. Robert Koerner and the Geosynthetic Institute for permitting NAUE News to republish this 11 August 2010 letter to the EPA (US Environmental Protection Agency). Your work and your involvement are appreciated.

Dear Sir/Madam,
We, as many others, are keenly interested in the final covering of "Coal Combustion Residuals". If we indeed mean "final" then the barrier system needs careful consideration between the available and reasonably economic options:
Single Material Composite Material

- *Geomembrane* (GM)*
- *Compacted Clay Liner (CCL)*
- *Geosynthetic Clay Liner (GCL)*
- *GM/CCL*
- *GM/GCL*
  *(*Called Flexible Membrane Liner, or "FML" in most EPA literature)*

If only a single barrier is to be used, a benefit/cost analysis heavily favors a geomembrane. If a composite barrier is to be used, such a benefit/cost analysis favors a GM/GCL composite.... You might ask, "what about CCL's"? Our answer is that a compacted clay liner simply does not belong as the final cover of any type of landfill! Between settlement cracking, desiccation cracking, root and/or animal penetration, a CCL's long-term performance cannot be relied upon.... In all respects, the GM's and GCL's are far better alternatives.

Very truly yours,
Robert M. Koerner, Ph.D., P.E., NAE Emeritus Professor of Civil Engineering at Drexel University, Director – Geosynthetic Institute

CONTENT

Further information: www.naue.com

Guarding against subsoil lifting

Bentofix® secures Weinmann and Schanz's new logistics center in Balingen

Businesses often select locations based upon infrastructure advantages. Logistics centers, in particular, play an important role. This was the case for Weinmann & Schanz in Balingen, located in the Swabian Alps, Germany. The site choice had a number of difficult problems, but Bentofix® solved them.

Rock layers are complex. Although it may sound trivial, they can torpedo construction in Balingen in Upper Swabia. When planning the construction of a new logistics center, engineers discovered a Lias rock layer in the new structure's intended foundation site. This rock increases its volume by dehydration, which increases pressure on the foundation and can potentially damage the entire structure.

After intensive discussion, a special solution was found utilizing NAUE Bentofix®. A geosynthetic clay liner (GCL) can ensure a constant moisture level with the ground and is very economical to install.

Encapsulating a potentially dangerous layer
In Balingen, this innovative geosynthetic solution involved the encapsulation of the rock layers that were at risk of drying out. The sealing product used was NAUE Bentofix® X2 BFG 5300, a polymer-coated GCL that's characterised by extremely low permeability. The installed GCL over the subgrade and under the concrete foundation minimizes, if not even prevents evaporation processes in the sealed zone. The potential threat of structural damage to the foundation due the potential risk of volume increase of the Lias rock during dehydration was mitigated.

Bentofix® provided numerous welcomed benefits. One of them was that the installed Bentofix® qualified as an smooth and flat surface for the installed insulation under the concrete slab. Additional security was derived from the multi-functionality of the GCL's composite structure. The high-swelling bentonite component of Bentofix® acts as a "self-sealing" barrier, in the event that the robust polymer coating is accidentally damaged. And the polymer coating ensures that the bentonite and the surrounding soil layer remain hydrated with a more or less constant moisture content.

Overall, the 24,000 m² warehouse and logistics center in Balingen was made possible with Bentofix® X2 BFG 5300. Construction took place over a short period (March - October 2010) and provided an economical, high-quality solution. The site has been given permanent protection against a dangerous drying out of the rock below. Valuable property has been made more so with Bentofix®.

A Prominent Site

Picture: Kai Mudra

Combigrid® secures the slopes of Schmalkalden's crater
The crater in Schmalkalden, Thuringen is the most prominent sinkhole in Germany. Gravel trucks rolled in for days following the November 2010 landslide that exposed the site. Then the geosynthetics arrived: Combigrid® now secures the area immediately surrounding the failure zone.

On the first night of November, the earth within the middle of a residential area collapsed. Geologists suspected that natural cavities were the cause and established test wells to monitor the situation. For three days the earth shifted until finally it settled, leaving behind a 20 m deep crater.
Gravel trucks and excavators brought in approximately 30,000 tonnes of 8/16 gravel and poured it into the crater's mouth. Securing the edge, however, was more critical. Right next to the massive hole was a partially slipped embankment, the remains of which were extremely unstable. This threatened a nearby apartment building. On 8 November, just seven days after the initial failure, rolls of NAUE Combigrid® were delivered to stabilise the slope.

Roughly 6,500 m² of Combigrid® 30/30 Q1 151 GRK 3 were used. From the former garage forecourt (now the area of the sinkhole) to the adjacent residential buildings, a wrapped-face wall was constructed. Five tiers of Combigrid® were installed using an envelope method along the front of the embankment to provide permanent stability.

Combigrid® is a unique geogrid/geotextile composite material that delivers reinforcement, filtration and separation in a single layer. These geogrid/geotextile composites are used in conjunction with soft and low CBR soils for applications such as base reinforcement, embankment reinforcement and pile cap platforms.

Geogrids Enable 160 km/h for Deutsche Bahn

NAUE Combigrid® and Secugrid® reinforce the railway base course on damp, marshy ground

The railway line between Berlin and Cottbus is being completely refurbished. The challenge: upgrade eight wet, boggy sections in the Spree Forest (Spreewald) between Königswusterhausen and Lübbenau to support train speeds of 160 km/h. The solution: base course reinforcement with a combination of Combigrid® 40/40 Q1 151 GRK 3 and Secugrid® 40/40 Q1.

Since 2008, the German Railway Authority (Deutsche Bahn) has been reconstructing the major rail link between Berlin and Cottbus. Currently, the nearly 60-km-long section between Königswusterhausen and Lübbenau is being redeveloped, which means that train traffic along this stretch will probably be halted until April 2011. The work will be worth it. Once reconstruction is complete, the new route will allow speeds of up to 160 km/h, which will shorten the journey by approximately 20 minutes.

Simple, but with high functionality

The wet-marshy subsoils of the Spreewald have presented a particular challenge to the project. Site investigations confirmed that the base course would need to be built up through eight marshy sections on the rail line in order to support the new speed. Four design options were available, one of which involved a combination base reinforcement system utilizing both Combigrid® 40/40 Q1 151 GRK 3 and Secugrid® 40/40 Q1 geogrids. Important criteria for choosing a solution included:

- Costs
- Construction feasibility in terms of local conditions (e.g., water table, space constraints)
- Regulatory approval of both the project design and individual materials to be used.

The use of durable geogrid reinforcement in the sub-base would provide the necessary permanent protection and stability where the non-cohesive soils have a high degree of overlap and/or are relatively thin. For the geogrid-reinforced base course, no special approval was required.

The base layer is 50 cm high and has two reinforced layers. The lower reinforcement is provided by Combigrid® 40/40 Q1 151 GRK 3, a geotextile-geogrid composite material with additional separation and filtration efficiency. The material's characteristics and application specification are in accordance with the Federal Railway Authority's (Eisenbahn-Bundesamt [EBA]) "Test Conditions for Geosynthetics in Approval Procedures of the EBA." Above the Combigrid®, a reinforcement layer of Secugrid® 40/40 Q1 was installed along with another 25 cm of cover soil. Secugrid® geogrids are also manufactured in accordance with the EBA's guidelines.

This use of Combigrid® 40/40 Q1 151 GRK 3 and Secugrid® 40/40 Q1 has been installed in all eight problem soil zones for base course reinforcement. Approximately 160,000 m² of Combigrid® and Secugrid® have been installed along this important, refurbished rail line.

Dynamic Duo Down Under:

Carbofol® and Bentofix®

When one of Australia's largest landfills sought to expand, engineers were concerned about the potential impact on groundwater, as well as the overall site's integrity. The new cell would need to be asymmetrical and utilize a steep-slope footprint, which presented challenges for designing in a secure barrier system and proper drainage management. The South Cardup Landfill's operator is Western Australian Landfill Services (WALS), a joint venture between SITA Environmental Solutions and Pioneer. Stringent environmental monitoring would be used in the construction of Cell 7. WALS turned to Golder Associates for design of the new cell; and Golder turned to NAUE's geosynthetics.

South Cardup is a successful, energy-generating landfill with a history of strong environmental performance. It was one of the first landfill facilities in the world to sell carbon credits. Methane generated in the waste is harvested and converted to power. Annually, this process prevents the release of roughly 115,000 tonnes of CO_2 - a dramatic number that is equivalent to removing more pollution than that generated by 31,000 cars. And the site provides power equivalent to 355,000 barrels of oils per year. Approximately 22,000 litres of leachate are collected.

For the new cell with its unusual shape, a double-liner system was selected to provide the best protection and maximize environmental functionality. Golder's rigorous design calculations and testing led to the specification of a combination barrier system utilizing Carbofol® geomembranes and Bentofix® geosynthetic clay liners.

Due to the long, steep slopes, a high-friction angle was required for the primary geomembrane liner. A 2 mm, structured Carbofol® MegaFriction geomembrane was the right choice, due to its unique, embossed surface. The structured, uniform studs provide excellent contact with the slopes to prevent liner movement.

Bentofix ® BFG 5000 was selected for its robustness and high-swelling bentonite. It provides efficient, easy-to-install rolls, thus lowering both delivery and installation costs; and the self-sealing bentonite and strong shear resistance of the geotextile outer layers provide extraordinary durability for long-term barrier performance. Bentofix® BFG 5000 features a cover nonwoven geotextile that has been uniformly impregnated with a second layer of sodium bentonite powder, which can help the installation proceed more efficiently versus installations where the overlaps must be sealed with additional bentonite.

Secured with NAUE's containment technologies, the South Cardup site continues in its role as an exemplary installation in Australia and as an environmental leader in the global waste management industry.

Exhibition and seminar schedules

30. - 03.12.2010	Pollutec 2010	Lyon, France
07. - 09.12.2010	Challenges and Opportunities on CLIMATE CHANGE	Bangkok, Thailand
11. - 14.01.2011	InfraTech	Rotterdam, Netherlands
03. - 04.02.2011	7. Fachausstellung Grundbau - Brunnenbau & 8. Österreichische Geotechniktagung	Wien, Austria
13. - 16.03.2011	Geo-Frontiers 2011	Dallas, USA
11. - 13.05.2011	22. International Mining Congress	Ankara, Turkey

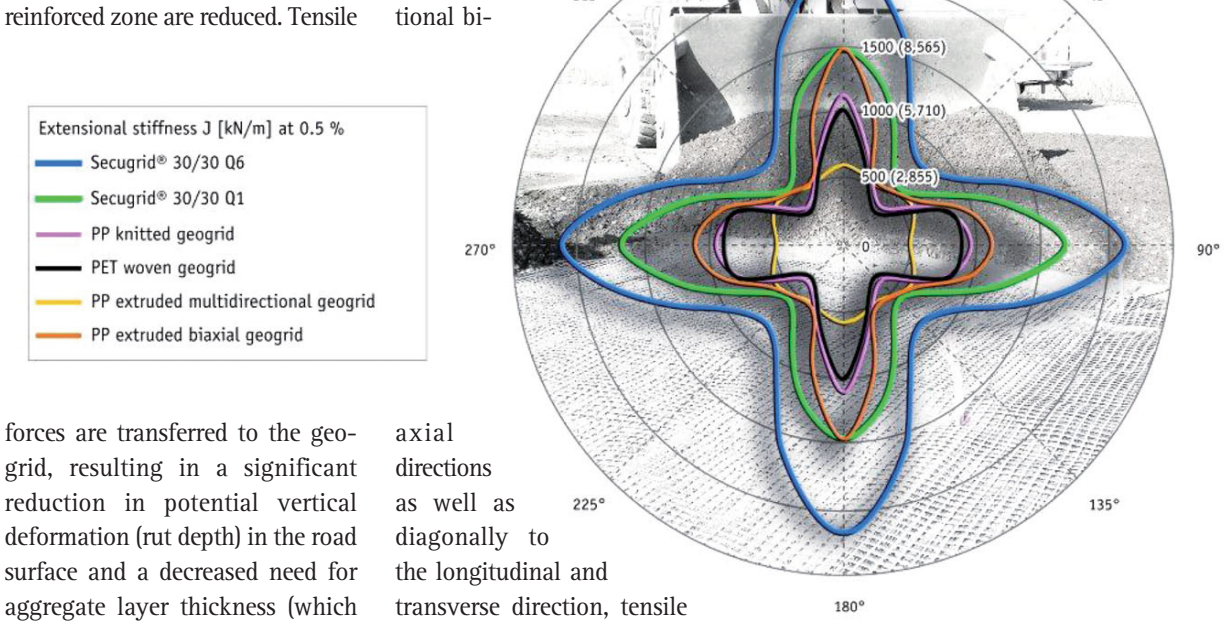
The Importance of Radial Stiffness in Geogrids

Traffic loads create lateral movements inside the base aggregate of unpaved roads. To restrain the aggregate laterally, geogrids are installed to reinforce soft or compressible foundation soils. The installation of geogrids between the subgrade and base aggregate creates a shear interaction known as the "interlocking effect."

As the geogrid is much stiffer in tension than the base aggregate, lateral stresses and strains in the reinforced zone are reduced. Tensile forces are transferred to the geogrid, resulting in a significant reduction in potential vertical deformation (rut depth) in the road surface and a decreased need for aggregate layer thickness (which reduces material shipments to the site and speeds up installation). Because traffic load stresses lead to an outward motion of the aggregate from the wheel--mainly in the direction of the traffic flow and perpendicular to it--the geogrid is mainly stressed in longitudinal and transverse directions. The shear interaction increases the elastic modulus and, thus, the stiffness or load distribution capacity of the base course. The ability of the geogrid to absorb the mobilized stresses at potentially low deformations is a key geogrid characteristic. It is also known as the "tensile modulus" or "secant stiffness".

Evaluation of geogrid stiffness

To examine the secant stiffness of Secugrid® geogrids in conventional biaxial directions as well as diagonally to the longitudinal and transverse direction, tensile tests according to EN ISO 10319 have been carried out at tBU Institut für textile Bau- und Umwelttechnik, Greven (Germany). These tests determined the radial geogrid stiffness at very low deformations of 0.5 %. The test results show extremely high secant stiffness values of ≥ 1,500 kN/m for Secugrid® 30/30 Q1 and values of ≥ 2,000 kN/m for Secugrid® 30/30 Q6 in both biaxial directions. Importantly, high secant stiffness values of ≥ 592 kN/m for Secugrid® 30/30 Q1 and ≥ 828 kN/m for Secugrid® 30/30 Q6 have also been achieved diagonally to the longitudinal and transverse directions. The same tests were carried out on polyester (PET) woven and knitted geogrids as well as for a multidirectional extruded polypropylene (PP) geogrids with triangular apertures. These results show that Secugrid® geogrids provide the highest radial stiffness values of all tested geogrids.



summarizes the minimum Radial Secant Stiffness values at 0.5 % elongation.

Geosynthetics promote tourism in Brandenburg

NAUE Terrafix® and Bentofix® provide a functional, economical solution for the Werbellin Canal

The economic importance of houseboats and pleasure boats drifting through rural canals should not be underestimated. But these boats so often must share space with big ships in busy channels. To better serve smaller boat traffic, the town of Marienwerder in northern Brandenburg decided to revitalize the entire length of the Werbellin Canal. Terrafix® and Bentofix® are preserving this renewed channel.

The history of the 20 km long Werbellin Canal goes back to 1765. But when the Oder-Havel Canal was built, it shortened the route to Lake Werbellin, which made approximately 3 km of the Werbellin Canal obsolete. The stretch became silted. Only about half was used, and that largely for agriculture.

Meanwhile, Brandenburg was fighting population loss. It found a partner in the Water Tourism Initiative of North Brandenburg (WIN). WIN aims to attract more tourists to Brandenburg's waters, tourists who will appreciate the tranquility and closeness to nature. The busy Oder-Havel Canal did not fit with that vision. Thus, the idea to revive the old canal in Marienwerder took hold. The Finow Canal branch to Lake Werbellin could open up the beautiful landscape to tourism, including to the renowned nature of Marienwerder.

In early 2009, the extensive construction work began on the 3 km route. The navigable passage width is designed for two 4.6 m wide boats, and the depth is 1.7 m. Due to the natural layout of the canal, three control sections were established. The middle phase of construction was key. It stretched roughly 1,300 m, and improving it called for embankment sealing with a bank-to-bank width of 45 m (including adjacent unpaved farm roads). Here, 45,000 m² of NAUE's Terrafix® 609 geotextiles and 40,000 m² of Bentofix® NSP 4900 geosynthetic clay liner (GCL) were installed for erosion protection, separation and sealing. Bentofix® seals the channel. The GCL consists of two geotextile components (the upper one a needle-punched nonwoven fabric, the bottom one a composite of woven and nonwoven geotextiles) encapsulating a layer of sodium bentonite. The secured, uniform layer of high-swelling bentonite is protected from erosion, thus ensuring long-term performance as an impermeable seal. The nonwoven geotextile outer layer increases the interface friction angle, which enables steeper slope installation, and it is robust for exceptional protection and durability. Also, the flexibility of Bentofix® allows it to accept normal site deformation and settling while maintaining a permanent seal.

Terrafix® geotextiles provide the stability against embankment erosion. The needle-punched nonwoven fabric is made of synthetic fibres, creating a three-dimensional, labyrinthine fibre and pore structure that simulates the ideal hydraulic properties of soil structures. Terrafix® is permeable to water. In the Werbellin project it provides both, separation and filtration, to prevent the washing out of the underlying soil.

Together with a new, small port in Marienwerder, the revitalised channel and the northern part of Brandenburg continue to be a welcomed, successful destination for water tourism.

contractor: joint venture Hydro - Wacht

Restoring water and hope

NAUE returns to Burkina Faso with a dam-restoring donation

High water may have destroyed a dam in Burkina Faso, but in record time it was replaced, thanks to one aid organization, local labor, and a donation of Terrafix® geotextiles from NAUE.

In 1976/1977, the aid organization Brot für die Welt (Bread for the World) and the evangelical development service KED helped construct a rainwater retention dam in the previously dry valley near Tikato and Solomnore in Burkina Faso. This installation allowed for the storage of potable water, which also helped provide irrigation for small grain and vegetable gardens. By 2007, more than 800 gardens had been established and were feeding 5,000 people. Developments such as this helped slow urban migration by giving these small villages more prospects for growth and opportunity.

Tikato and Solomonre are located in the Sahel, an ecoclimate that serves as a transition zone between the Sahara desert to the North and the Sudanian savannas to the south. Its rainy season lasts five months. The construction of the artificial lake sustained the villages each year until the next rainy season.

However, on 30 and 31 July 2009, a record rain fell: 140 l/m². The dam failed under the hydraulic pressure, with one side giving way. The water flooded the surrounding villages and washed away some houses, drowned more than 700 cattle, goats, sheep and chickens, and destroyed 31,200 kg of supplies like millet, rice and peanuts. In one moment, both the current and future harvest was destroyed, and many lives already challenged by poverty had to endure sudden homelessness.

Donating 124 rolls

The charitable group Arbeitskreis Brot für die Welt – TIKATO sought both dam restoration donations and immediate relief and provision for the affected villagers. Within this context, geologist Dr. Wilhelm Wilmers, a member of the charitable working group, contacted NAUE's executive management and requested help. Dr. Wilmers had been the head of the Hessian Testing Institute for building and construction material in Wetzlar (Germany) and he also was the director of the DGGT research group 5.3 "geosynthetics in road constructions". This position called his attention to geosynthetics and he contacted NAUE for help. It was not an unfamiliar site for NAUE. In 2007 NAUE had donated sand bags for a dam repair project. (That zone did not fail during the 2009 deluge) Once again, NAUE responded, donating 124 rolls of Terrafix® 609 nonwoven geotextiles. Each roll measured 50 m long x 5.8 m wide. The mechanically reinforced nonwoven is 5 mm thick and has a mass of 640 g/m².

This robust, flexible nonwoven filter material was installed between the rebuilt dam's fine-grained core and the coarse and/or mixed-aggregate cover layer atop the dam. Terrafix® would provide the filtration stability that was missing in the previous design, thus preventing the shifting of fines that could destabilize the structure.

Because the dam had suffered four serious breaches, a total rebuild was decided upon. Clay was taken from the site and compacted. Villagers dug a ditch by hand along the overflow site, the foot of the embankment, and the concrete walls. Riprap and vegetation were added later.

Cut, Roll, Carry, Unroll

When the 124 rolls of Terrafix® arrived on 11 May 2010, local labor had already carried out all of the site preparation with the help and supervision of an experienced construction company. The geotextiles were installed across the dam and over the embankments and crown. Young men from the village carried to the top of the dam the rolls that had been cut-to-size. There, they unrolled the material manually and secured them in the ditch at the foot of the structure. To protect the geotextiles from UV exposure, wind uplift and vandalism, the villagers covered the new Terrafix® with hand-broken laterite stone. Many people came out to help. The dam had to be finished before the first rain. By the end of May, the water-exposed side was secured and protected by riprap. The structure was ready.

The TIKATO aid organisation received word on 8 June 2010 that it was raining heavily upon the new dam and that the lake was being replenished. The combination was monetary donations and dedicated locals, and access to easy-to-realize, efficient geosynthetic design has restored not just a dam for the people of Tikato and Solomnore but their self-sufficient identity. New gardens and new homes continue to be established.

NAUE's State-of-the-Art Solutions for Romania's Railways

By Bogdan Tronac – NAUE Romania

The 225 km railway from Bucharest to Constanta is the final part of the Fourth European Corridor, which begins in Dresden, Germany and passes through major cities such as Prague (Czech Republic), Bratislava (Slovakia) and Budapest (Hungary). It is a vital link for the transportation of passengers, finished goods and raw materials between Eastern and Western Europe. It also delivers freight to and from the Port of Constanţa (Romania).

Historically, speed along the double line in Romania was limited to 120 km/h for passenger trains and 95 km/h for freight. Romania's railways authority, CFR (Cile Ferate Române), set out less than five years ago to modernize the system, a move that would increase passenger train speed to 160 km/h and freight to 120 km/h.

The extensive 665.2 million Euro rehabilitation needs involved excavation of the existing ballast and base course layer, the complete removal and exchange of the old rails, new electrical, signaling and communication systems, and the rehabilitation of bridges, culverts, railway stations and secondary lines.

The first section of the railway line, which runs from Bucharest-North to Bucharest-Băneasa and from Fetesti to Constanţa, was awarded to a consortia of companies: Swietelsky, Wiebe and Takenaka, and was supervised by Pacific Consultants International. The second section, from Băneasa to Fundulea, was awarded to the Greek company Terna and started simultaneously with the first part under the supervision of DE Consult. The last section, from Fundulea to Fetesti, was awarded to the Italian company Astaldi under the supervision of DE Consult. That final leg began roughly a year later.

For the first two sections, the main rehabilitation work was carried out using the multifunctional RPM 2002 train. This unique machine is capable of performing in one pass almost all of the operations related to the excavation of the existing structure

underneath the rails, screening, cleaning of the ballast and FPL (Frost Protection Layer), installation of the filtration/separation geotextile and reinforcement geogrid, and installation and compaction of the new FPL and ballast layers. For the third section, work was performed through more conventional methods.

The project's technical specifications required a high deformation modulus (minimum 80 MPa) for the FPL. A firm foundation was needed to support trains passing at speeds up to 160 km/h. For all sections, geogrids and geotextiles were specified. A nonwoven geotextile separation/filtration material of 250 g/m² would provide separation between the FPL and supporting layer. A 150 g/m² nonwoven filtration geotextile would be used for the longitudinal drains. And biaxial geogrids of 30 and 40 kN/m would reinforce the base course layer.

For the first two sections, NAUE Romania delivered Secutex® 251 GRK 4 C geotextile for filtration and separation, Secutex® 151 GRK 3 C for filtration, and Secugrid® 30/30 Q1 soil reinforcement geogrid.

For the third section, despite using more traditional construction methods, a truly unique geosynthetic was requested: a geotextile detectable by radar for the FPL/support layer separation. CFR wanted to be able to check and confirm the thickness of the installed layers and to be able to monitor and identify fluctuations in the track construction that might indicate the need for base course repair before problems developed at the surface.

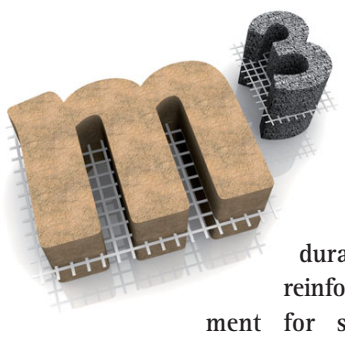
NAUE GmbH & Co. KG was the first company worldwide able to produce and deliver this class of Secutex® material. Known as Secutex® RDG (Radar Detectable Geotextile), it has proven itself in the field. Installed under the frost protection layer, Secutex® RDG is able to reflect the electromagnetic waves emitted by georadar equipment. Reflecting stripes placed at regular distances along the geotextile make this possible. Every stripe is trackable. In the data readout, the apexes all the hyperbolas may be connected, and quite easily one can identify an inferior base course level or confirm the quality of the construction.

By using the top-quality geosynthetics from NAUE GmbH & Co. KG, Romania's railways are establishing a new standard of quality and safety. The utilization of Secutex® RDG has provided essential quality assurance in construction and enabled state-of-the-art post-construction monitoring of the railway's structural integrity.

m³: Steep Slope and Reinforced Structures System

NAUE offers more service: calculating design and materials

Limited land for development and difficult terrain are usually the reasons for constructing steep slopes. Geogrids are known for outstanding,



durable reinforcement for steep slopes, but: do all designers know the full range of options for various slope scenarios? The slope face may be "only" the edge of the actual construction work, but inattention to it can lead to failure, structural damage and the need to reconstruct the slope. NAUE m3 provides a system approach to slope reinforcement, including design.

The primary reinforcement of steep slopes is provided by Secugrid® geogrids. Their durability and strong tensile strength (at low elongation) is rooted in the highly-oriented polyester (PET) flat bar construction, bars that are uniformly extruded and drawn to ensure a continuous, homogeneous molecular structure. Secugrid® secures the core of steep slopes and reinforced structures and in some systems Secumat® acts as the erosion control protection measure. Other variables to consider include slope angle, line, use and facing. This leads to complex options - NAUE m³ makes safe, economical design more easily attainable with six ready-to-use systems:

NAUE CLAMP

The NAUE CLAMP system for reinforced earth structures utilises horizontal layers of Secugrid®. The slope face is protected by the erosion control system Secumat®. This system is used for vegetated slopes to 50°.

NAUE WRAP

The NAUE WRAP system for reinforced earth structures utilises Secugrid® in wrapped, reinforcement envelopes along slope faces. The wrapped wall construction is very flexible, so temporary relief forms (eg, panels) support the structure during assembly and is used for vegetated slopes to 70°.

NAUE STEEL T

T stands for "temporary." In NAUE STEEL T, Secugrid® is used in the envelope method to reinforce the earth structure. Steel mesh provides the temporary, effective installation support (using formworks). Applications are e.g.: Rehabilitation of failed slopes, protection of slopes up to 70°, embankments or noise barriers

NAUE STEEL P

P stands for "permanent." A galvanized steel mesh provides a permanent, effective, stable face. Secugrid® reinforces the earth structure. The applications are the same with NAUE STEEL T.

NAUE GABION

A supporting front of gabions characterises NAUE GABION. Secugrid® is installed between the gabions and anchored in the rear of the earth structure, which simultaneously reinforces the soil and wall face. Typically applications are: Retaining walls of all kinds up to 89°, embankments, bridge abutments, replacement for gravity walls, noise barriers or soil pressure alleviation.

NAUE BLOCK

A supporting face of stone/block, precast concrete or natural stone defines NAUE BLOCK. Secugrid® is installed between the facing elements and anchored in the soil, simultaneously reinforcing the slope/wall face and core. Applications are the same as with NAUE GABION.

NAUE PANEL

A supporting precast concrete or natural stone defines NAUE BLOCK. Secugrid® is attached to the front facing and anchored in the soil, simultaneously reinforcing the slope/wall face and core. Applications are the same as with NAUE GABION.

NAUE NAIL

The NAUE NAIL system incorporates soil nails for slope stabilisation. The system utilises Secugrid® geogrids for primary reinforcement in the slope direction. The slope surface is covered with Secumat® 5/5 Q1 ES 601 erosion control mats. Applications are e.g.: Slopes up to 65°, temporary construction stabilization, sites with soft or loose soils, sites with limited hard rock

Individual Calculations

Critical to the viability of the overall design is the calculation of the individual elements and the complexities of how they work together. NAUE assumes this critical role, in cooperation with experienced partners. Users of the m³ system save time and effort, enjoy security in planning and costing, and can rely on quality and durability in the final design. Brochures and other assistance for the m³ systems are available.

On the Waterfront in Slovakia

NAUE BLOCK's functional, economical, high-strength solution

A steep-slope retention structure with concrete blocks and NAUE Secugrid® reinforcement enabled the latest section Slovakia's R1 highway to be built at Zarnovica...despite a difficult footprint along the banks of the Hron River.

The R1 is one of Slovakia's central transportation arteries. The R1's planning and construction began in the 1970s, and since then it has been regularly expanded and is now a major thoroughfare. It starts in the western part of Slovakia (in Trnava) and goes to Banská Bystrica. The road's central stretch, between Nitra and Zvolen, runs along the Hron River. At Zarnovica, the river bank encroaches so closely upon the road in some portions that only 6 to 7 m of space is available to support construction. This fact makes natural banks along the road impossible, both for logistical and cost reasons and flood concerns. A flood event on traditional embankments might lead to road slipping and failure.

Simple, yet highly functional

To address the Slovak Traffic Ministry's (NDS) concerns, the NAUE BLOCK system was selected. Two 120-m-long reinforced wall structures with a grade of almost 90° were constructed. The NAUE BLOCK system utilized KB-Block concrete blocks for the front elements and Secugrid® geogrid for the primary reinforcement.

Not only is this construction technique more economical than traditional concrete construction, but it can be carried out in simple, efficient steps with a minimum of machines required to perform the work – a fact that was greatly appreciated in the project's tight footprint. Also, the use of Secugrid® for the reinforcement provides true long-term strength and performance that further enables greater design flexibility in the exterior facing choice.

For Zarnovica, the 20-cm-high wall blocks feature a hollow interior zone that is filled with gravel upon installation. The Secugrid® geogrids panels then interlock with the front of the concrete stones to create a strong connection. The insertion of plastic mounting pegs between successive wall blocks provides further security against block movement. Ultimately, the total system transfers the pressure bearing down on the outer face of the construction to the geogrid reinforcement within.

The Secugrid® geogrid layers were installed 60 cm from one another, creating a uniform system with three gravel-filled concrete blocks along the front face of each reinforced layer. The anchored lengths of Secugrid® were between 4.5 and 6 metres.

The block face in a construction of this nature provides essential UV protection for the geosynthetics, which ensures the long-term durability of the system. It also protects against vandalism and provides soil erosion control in the event of flooding.

As the fill material immediately available in Zarnovica did not have the required permeability to drain off precipitation without adding to the wall's hydraulic pressure, a 30-cm-high gravel drainage layer was installed between the soil body and the wall block. A nonwoven geotextile (Secutex®) separated the soil and drainage layer, retaining fines and ensuring long-term permeability performance.

During construction, a unique situation was also dealt with. The pile footings for a noise barrier wall were being retrofitted, and this construction in the tight project zone meant that they needed to be driven one metre behind the NAUE BLOCK wall and through

the Secugrid® layers. Tensile issues were not a concern, however, as punch-through zones were figured into the relevant Secugrid® geogrid layers. The concrete piles absorb the ground pressure in front of the exterior block face.

Altogether, more than 5,000 m² of Secugrid® 40/40 Q1, 20,000 m² Secugrid® 80/20 R6 and 1,200 m² of KB concrete blocks were installed. The customer decided on using Secugrid® due to its high absorption of tensile forces at very low elongation, its basic robustness and the high cost-benefit efficiency. In fact, the Zarnovica project team had initially designed the site for reinforcement zones to be 40 cm thick. The selection of the NAUE BLOCK system with the outstanding reinforcement strength of Secugrid® allowed the geogrid layers to be installed every 60 cm. This adjustment, enabled by NAUE's materials, provided an enormous savings during installation in terms of material shipping, handling, labour and time.

With Competence and Charisma

Starting in 2011, the staff of the NAUE group will have to adjust to Prof. Dr.-Ing. Georg Heerten's absence from his office in Fiestel. An era is ending, one that began by chance in 1981. Early in the '80s, geosynthetics manufacturers were still looked upon as carpet dealers in the geotechnical field. They were definitely not the first address for employment for a recently graduated hydraulic engineering Ph.D.

However, Dr.-Ing. Heerten worked intensely with geosynthetics in his dissertation, "Geosynthetics in hydraulic engineering: testing, app-lication and success." Another strong argument to start his career at NAUE in Fiestel was the near proximity to the North Sea, which he loved and which he could reach within an hour's drive.

When Dr.-Ing. Heerten started his employment on 1 January 1981 as chief of the technical department, he vowed that he would never tour the country with a sales suitcase in his hand.

However, he is not only a technician and an engineer; he also has had the sales gene in him. This gene, combined with the vision to place geosynthetics in geotechnics as a superior material, has directed his thinking and dealing and writing on these topics. His contributions are plentiful and have been appreciated. Dr.-Ing. Heerten's insight can be found in more than 200 publications and presentations, both nationally and internationally. His tremendous talent and enthusiasm was also recognized by the Naue brothers, who nominated him at the age of 35 to a managing director position with the newly founded NAUE Fasertechnik. Three years later, they also made him a part owner. This trust in him would repeatedly pay back over the years. Under his leadership, Dr.-Ing. Heerten developed and patented products such as Bentofix® and Secugrid® and made them international success stories.

What started as a small seed in Fiestel, developed into an internationally active company with global sales and manufacturing operations and a staff of more than 450.

Another primary interest of Prof. Heerten is the training and support of our young engineering community. In addition to his teachings on geosynthetic engineering at RWTH Aachen University, - in recognition for this, Dr.-Ing. Georg Heerten was promoted to a professor on 21st September 2004 - he has also been in charge for many year of the Forum for Young Geotechnical Engineers, which takes place during the biennial Baugrundtagung event (Geotechnical Conference) of the German Geotechnical Society (DGGT). This energy and activity is characteristic of him. When he began teaching at Aachen, it was hard for him to accept being outside of the students. It made him seem like an old man, but he felt like one of them. He felt their enthusiasm for discovery. With this attitude and the slogan "There is no such thing as a dumb question; it is only dumb not to ask a question", he has found high recognition. Even today he continues to accompany the students during their annual student excursion.

In addition to his managing duties at NAUE, Prof. Heerten serves in many national and international organizations and working groups, such as TC5 on Environmental Geotechnics and TC9 on Geosynthetics and Earth Reinforcement for the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

Prof. Heerten mentioned early that it was his wish to move out of the operative management of the NAUE group. The company respected his decision and has had ample time to properly plan for the transition.

To be certain, it will be a very unusual feeling for all when, as the next year progresses, Prof. Heerten is not part of the day-to-day operations as he has been for the past 30 years. We cannot expect forever from anyone. Still, there is good news in this: Prof. Heerten will continue to offer his council and energy as a consulting managing director.

In general, though, the idea of "retirement" for Prof. Heerten looks quite different than it does for many. Much awaits him professionally. On 4 November 2010, Prof. Dr.-Ing. Heerten was elected as DGGT Chairman. In this four-year leadership position he succeeds Prof. Dr.-Ing. E.h. Manfred Nussbaumer.

We would all like to congratulate Prof. Heerten and wish him success on this new set of responsibilities and service. The main aim of the DGGT with its 2000+ members, and which is celebrating its 60th anniversary in 2010, is to support geotechnics, especially in research, education, industry and government. As chairman of DGGT, Prof. Heerten will continue to be active in the geotechnical field; and the students of Aachen will not be without his lectures on geosynthetics and geotechnics, as he will continue to teach.

With this in mind, we still hope that Prof. Heerten will be able to spend more time with his family and his hobbies. He has devoted so much of the past few decades to his business life; one assumes there remain a number of wishes concerning free time.

Dear Georg, we wish you and, of course, your dear wife Marlis all the best and good health. The NAUE Group and staff thank you for your 30 years of involvement. Our company would not be where it is today without you.

Editor: Management. Implementation: Department for Marketing. Circulation: 2,000. Design/Production: TwoTypes². Bahnhofstr. 14, 32312 Lübbecke, Germany. Reproduction, including extracts, may only be made with the prior permission of the publisher.