

NAUE



NEWS

NAUE NEWS December 2013

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Further information: www.naue.com

The year 2013 is drawing to a close and, as expected, it has been a difficult year. Not only did the weather lead to a late start to the construction season, but the efforts of many countries to consolidate their budgets had a negative effect on the extent to which they were prepared to invest in publicly financed infrastructure projects. In addition, many major construction projects suffered severe delays.

But there is hope that this trend will not continue in the coming years. The European Commission has decided to exclude credit-financed, growth-enhancing public investment from the calculation of the 3% deficit rule in the Stability Pact.

This decision has improved conditions, so that the EU States can again increase spending on infrastructure. The same trend is now evident in

Germany. In their election documents both the CDU and the SPD pledged to spend more money in future on the ailing traffic infrastructure. And the latest "hundred-year flood" has again demonstrated the value of investment in modern construction methods.

All the dykes refurbished with our Bentofix® bentonite mat in the 10 years since the major flooding of the Elbe in 2002 withstood the floods in the spring of 2013, thus protecting the lives of people and animals, and of assets worth billions of Euros.

In line with the saying "there's always a next time", we can only hope that there will be no decline in the readiness of Authorities to continue to invest in modern dyke- and flood-protection measures, and thus minimise the dangers of and damage resulting from future floods.

In the last edition of NAUE NEWS we reported on the use of NAUE geotextile sand containers as the scour-protection system for the first offshore wind farm. The offshore wind farm Amrumbank West is being constructed 35km north of Heligoland to supply 300,000 households with power generated by 80 wind turbines.

Peter Madsen Rederi A/S, the contracting company charged with the installation, started filling the one cubic metre-sized sand containers on the Danish island of Rømø at the end of last year. Work on installing more than 30,000 sand containers commenced in April 2013.

Significant logistic advantage was realised by the fact that the construction of the foundations and the installation of the scour protection were able to be carried out independently of one another.

The commissioning of the ultramodern 3.6 Megawatt plant in the summer of 2015 should usher in savings of up to 740,000 tons of CO₂ on an annual basis.

We have ambitious objectives for 2014. Bentofix® XF, a bentonite mat with an embossed, rough polyethylene surface – newly developed last year – can now also be produced in our Malaysian plant. Additionally, the surface structure of our Carbofol® Friction geomembrane has been further enhanced; this geomembrane will be available for sale at our Tönisberg plant from January 2014.

Construction work is currently underway for a new production building at our plant in Fiestel. Work on the erection of a new, ultramodern carding line will start in March or April, and it should commence production of our Secutex® nonwovens

by summer 2014 at the latest. The high levels of investment at all our sites are visible proof that we view the future with optimism, and that, with the help of a competitive production and product portfolio, we intend to strengthen our position as one of the world's leading manufacturers of geosynthetics.

For now, we would like to wish all readers of NAUE NEWS a relaxing, peaceful Christmas and a good start to the New Year.

We would also like to thank all our customers for the trust they have placed in us, and all our employees for their loyalty and dedication.

Did you know...?

Lessons learned with Combigrid®
Our new flyer "Combigrid®-soil reinforcement, separation and filtration combined in one geosynthetic" has eight lessons in which the advantages of this 3 in 1 composite product is described.

Combigrid® combines knowledge, experience and technology and creates a new dimension of a geosynthetic reinforcement.

If you are interested in this flyer please send an email to info@naue.com and ask for the flyer "Combigrid® – Lessons learned".

Safer river dykes with Bentofix®

The Ónod village is situated at the eastern foot of the Bükk Mountain (East-North Hungary) on the bank of the river Sajó. In June 2010, a major flood hit the area, damaging many homes and causing the total collapse of others.

The extreme flooding and the substantial damage it caused highlighted the need for more effective flood protection measures in the region. The Hungarian government took up the issue and by January 2011 had approved a plan to build a new dyke system in Ónod. Construction began in summer.

In the absence of good clay resources in the area, the project team hoped to utilize nearby sandy gravel in the dyke construction. This would significantly improve the project's economics – but only if a suitable, safe engineering solution could be found to make the local

fill acceptable. Engineers from BBG proposed the incorporation of a geosynthetic clay liner (GCL) as an alternative to compacted clay.

BBG's geotechnical stability and hydraulic efficiency calculations showed how a geosynthetic clay liner would serve as an excellent water-side sealing

system. GCLs are also far more economical and environmentally friendlier than compacted clay. A single truckload of GCL rolls, for example, can provide

a barrier equivalent to 150+ truckloads of compacted clay. The choice to go with GCLs not only reduced transportation costs and pollution significantly, it also removed the need for excessive harvesting and processing of natural clay resources.

Bentofix® NSP 4900 geosynthetic clay liner, manufactured by NAUE GmbH & Co. KG, was selected based upon the design's needs. For all load and stability investigations that were conducted – e.g., water-side, land-side, crest water level, internal saturation with pore water pressures – Bentofix® excelled.

The slope inclination of the dyke on both sides was designed to be 1:3, with an average height of 3.2m above the original ground level and a maximum height of 3.4m. Roughly 64,000m² of Bentofix® NSP 4900 GCLs were installed on the water side of the dyke



and covered with 1m non-cohesive soil and top soil for the establishment of grass vegetation. (The non-cohesive cover soil also provided a strong deterrent to burrowing rodents.)

Ultimately the design has accomplished its goals: cost-effective construction and a safe, long-term flood defense design.

Renewable energy heads out to sea with NAUE

As part of the UK government and the Crown Estate's ongoing renewable energy incorporation targets, the Gwynt y Môr wind farm is emerging in the Irish Sea just off the North Wales coast in Liverpool Bay. The RWE npower renewables-developed site will supply power to 400,000 UK dwellings. It will be one of Europe's largest offshore wind energy installations when it is completed in 2015. NAUE has been involved from the very early design stage with the consulting engineer and the civils contractor.

NAUE has provided the complete geosynthetic design and product solutions for the redevelopment of the Cammell Laird Shipyard, which serves as the handling and storage facility for the 160 very large turbine parts as well as other equipment necessary for Gwynt y Môr's construction. Though the jobsite is 80km away, this Birkenhead-situated shipyard is essential for economically managing the project. The turbine components and other necessary project equipment arrive from all over the world. At Cammell Laird the components are assembled prior to being loaded onto vessels for site delivery.

NAUE's work has centered around reinforcement for the construction of 240m of unbound pavement in the handling area and scour protection for the port entry via the building up of a pre-existing concrete ramp and the improvement of the port's sea defenses against the Mersey River's challenging tidal conditions. In the handling area, Secugrid®

30/30 Q1 and Combigrid® 40/40 Q1 151 GRK 3 geogrids have been installed to provide sufficient bearing capacity. As the turbine components are transferred between vessels or storage areas, they apply high loads to the site. The reinforced pavement ensures the site can sustain those loads over the projects many years of operation.

Secugrid® (which is also the geogrid component of Combigrid®'s geotextile-geogrid composite reinforcement solution) offers exceptional ground stabilisation performance. Its flat bars, firmly welded at the junctions, resist tensile force loading with very low elongation. This results in an immediate force connection and interlocking with the fill soil without primary deformation. These geogrids have been used in basal reinforcement and foundation improvement applications at ports and container storage yards, as well as with road and railways, around the world.

The building up of the concrete ramp and the improvement of the sea defenses in the holding area with Secutex® Soft Rock sand containers, Secugrid® 30/30 Q1 and Combigrid® 40/40 Q1 GRK 3 geogrids complement the roadwork and ensure the long-term stability and efficiency of the site.

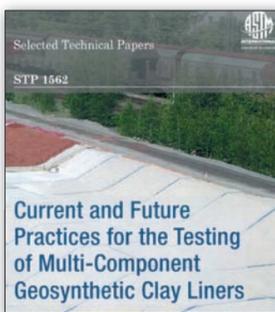
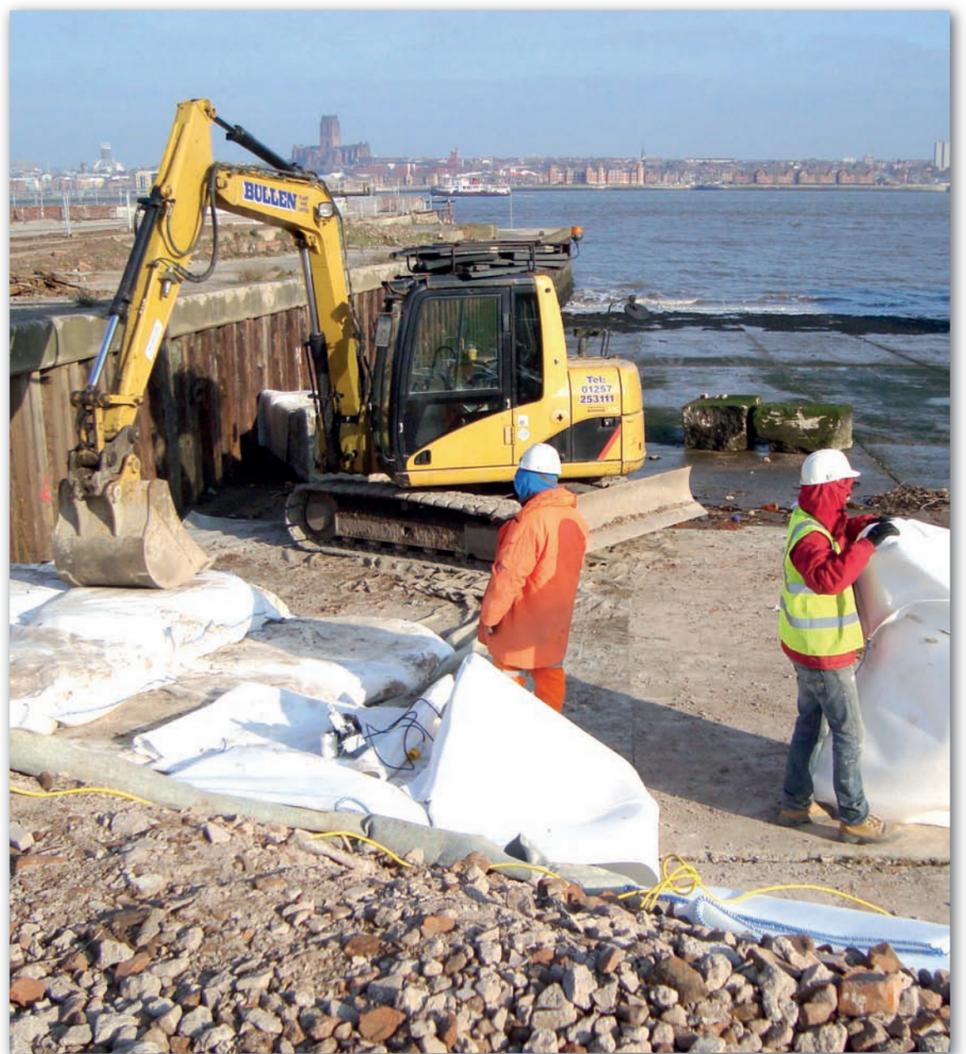
Soft Rock is a unique solution for wave energy diffusion. The robust nonwoven Secutex® geotextile bags can be filled with on-site sands to prevent the need for special fill and they are designed to provide years of service even in exposed

environments and against strong tides. The Soft Rock system has already been used internationally in numerous coastal protection and beach renourishment applications for an economical, highly effective, easy-to-install solution.

The Secutex® Soft Rock Type E sand containers used in this sea defence role have been selected to protect the unpaved road from being washed away by the River's volatile tides. The solution has held strong in the face of the waterfront activity.

Soft Rock has allowed for quick, uncomplicated filling of the geotextile containers and has enabled the contractor to perform the work ahead of schedule and within budget – which has allowed the real focus to rest where it should: 80km up the coast at Gwynt y Môr's construction.

Like the tide itself, the ships come in and go back to sea.



Did you know...?

ASTM D35 Publishes Geosynthetic Clay Liner Symposium Book

During the June 2012 ASTM meeting of Committee D35 on Geosynthetics, a special symposium was held on "Current and Future Practices for the Testing of Multi-Component Geosynthetic Clay Liners." Here in 2013, the book from that gathering has been published in print and digital formats.

Geosynthetic clay liners (GCLs) have certainly been a steadily innovated materials group. Their composite structure has enabled them to benefit from advances in their components and how their components are joined, which in turn impacts how the overall GCL can perform. The breadth of applications has expanded. The strength of performance has increased. The economic and sustainability benefits have become clearer.

The most recent symposium addressed this deeply, with 15 papers from an international group of practitioners who have been at the heart of GCL advances in manufacturing, design, and installation.

"Current and Future Practices for the Testing of Multi-Component Geosynthetic Clay Liners" stands as an important contribution to the field's understanding of the evolution and future path of GCL usage in environmental protection and barrier systems.

You can order this book at www.astm.org/



Refurbishment of a playing field on ground liable to subsidence

The historic playing field of SV (sports club) Güllesheim 1926, Germany, was scheduled to be refurbished during the summer

break at the end of the second half of the 2012 football season. The original turf field was to be replaced by a new, modern,

artificial-grass playing field. Since the playing field is situated in a former mining region, additional measures had to be taken to ensure the safety of the area to reduce the risk of danger should any old underground mine workings collapse. In order for the project to qualify for additional State funding, the necessity for the planned safety measures had to be confirmed in a soil report.

This report confirmed that there were indeed several old galleries under the area in question in the former mining region. An economical solution had to be found if the area – classified as "Danger Class 1" – was to continue in use as a sports ground. Further operation as a sporting complex would not have been permissible without precautions

against the risk of surface failure (sink-holes). And to rebuild the complex at a different location was not an alternative, because the costs involved would be greater still.

Prevention of potential mining subsidence by conservative construction methods is possible – but the specialist civil-engineering methods involved are very costly. The client therefore called on the services of BBG Bauberatung Geokunststoffe (engineering consultant) to find an economical solution.

Several state-of-the-art, technically sound alternatives using high-strength geosynthetic reinforcement (geogrids) were developed. The Verbandsgemeinde (Municipality Association) in Flammersfeld (the

client), in co-operation with the contractor AS-GmbH E. Abresch Straßen- und Tiefbau, decided on a solution with a single layer of geogrid reinforcement.

Because of its extremely low creep tendency and its high load uptake at low strain, Secugrid® 400/40 R6 was chosen as the reinforcement product.

The relevant parameters were then used in the design calculations. In accordance with these calculations, Secugrid® 400/40 R6 was laid at a depth of 1 metre below the planned playing-field construction. The former mining galleries are situated at a depth of 25 metres, but the use of the Secugrid® single-layer reinforcement means that, in the event of a collapse, the maximum depth of the

subsidence crater at the ground surface is reduced to 1 metre. Since the reinforcement ensures that – in the event of a gallery collapse – the subsidence depression at the ground surface develops only gradually, there remains ample time for people to move away from the danger area. After any collapse event, the damaged area can be repaired by filling the cavity.

Thanks to the use of Secugrid® geogrids, the sports complex, which is used by two schools and two sports clubs from Güllesheim and Horhausen in addition to SV Güllesheim, was refurbished and reinstated in a safe and economical manner.



Upgrading the Rostock - Berlin railway line



Europe has long utilized the railway as a primary means for connecting cities. In Germany, railways play a critical role for business, tourism and freight. However, the country's heavy use of rail has at times made upgrading the system difficult. Upgrades require either entirely new lines to be constructed or whole railway connections must be taken out of service to enable track improvements. This has been a common trend in recent years as high-speed rail capacity has increased and population shifts have necessitated new routes.

The new Rostock - Berlin route has long been in the planning and is of particular symbolic value as it unites Germany's capital with one of the historic

industrial centers that was lost to East Germany after World War II. Today, Rostock is the largest city in Mecklenburg-Vorpommern, a northern state. The city lies along the Warnow River and its urban area extends up to the Baltic Sea.

Deutsche Bahn had targeted this route for a significant upgrade: finding a way to reduce the travel time to less than 2 hours, as well as significantly increase the impact of commercial transport to and from Rostock's increasingly important port.

A Difficult Route

The available land between Rostock and Berlin is not ideal for new transportation projects. There are numerous northern wetlands with peat and other

substandard bearing soils to contend with. One stretch was especially difficult. A nearly 7km section of bog and fen-dotted lands caused considerable concern and redesign debate.

A geogrid reinforced load transfer platform (LTP) design over piles for embankment construction over peat was selected.

NAUE Secugrid® 400/100 R6 geogrid was selected after stringent Federal Railway Authority (EBA) analysis and approval. EBA placed an emphasis on safety with the project's reduction factors needing to show that the geogrid-reinforcement could work for the given concrete pile layout and embankments up to 7m height.

High tensile strength and axial stiffness had to be demonstrated. The commuter trains passing over these zones would be traveling up to 160km/h (100mph) and freight trains would be permitted for up to 25t axle loads.

Secugrid®, with its rigid, flat bar construction, welded junctions and robust performance fit the bill.

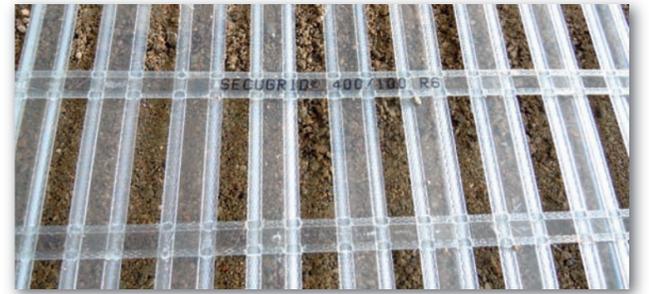
Construction

Construction of the new, high-speed capacity line took place over 7 months. Three peat zones were staged, with each section requiring more reinforcement than the last. Multiple portions included geogrid panel pre-assembly or protection installation beneath large on-site tents.

Phase 1 involved 230m of LTP and the installation of more than 20,000m² of Secugrid®. The panels were pre-assembled in 5 forms to meet the specific engineered installation plan of the site.

Phase 2 involved a 395m stretch of LTP and the installation of nearly 39,000m² of Secugrid®. This portion required 9 pre-assembled panel sections.

Finally, Phase 3 covered 820m of LTP and more than 87,000m² of Secugrid®. Sixteen pre-assembled panel arrangements were required.



Each LTP zone involved a multi-layer construction. The vertical piles were installed in a grid pattern at intervals of approximately 2m x 2m and up to 2lm in depth. The first of two high-tensile Secugrid® layers was then installed perpendicular to the embankment axis to absorb lateral thrust forces of the embankment. A 15cm layer of compacted fill was then placed, followed by second layer of Secugrid®.

Next, a third layer of Secugrid® was installed to serve as an envelope to the design. Wooden formwork was installed along the perimeter to provide support, the geogrid was wrapped, and once the layer was completed the formwork was removed.

Additional compacted fill was placed and a final, fourth layer of Secugrid® installed to complete the LTP.

One of the advantages of the selected geogrid were its rigid, flat construction. This enabled

efficient, flat, taut installation and high factor of safety – exactly what the Railway Authority demanded.

In total, 146,000m² of Secugrid® 400/100 R6 was installed across the three peat zones. Construction began in September 2012 and the key phases involving geosynthetics took place between January and March 2013.

NOTE: The Rostock - Berlin Railway project also unites two important international geotechnical events. In 2012, the German Geotechnical Society (DGGT) co-organized the 12th Baltic Sea Geotechnical Conference in Rostock; in 2014, the DGGT will co-locate its biennial conference with the International Geosynthetics Society's (IGS) quadrennial International Conference on Geosynthetics (10ICG). The 10ICG will be held in Berlin!
www.10icg-berlin.com

The secret of Stonehenge: NAUE Combigrig®!

Wiltshire, England, is home to one of the world's most famous and fascinating monuments: Stonehenge. Created thousands of years ago, the enormous standing stones have played a significant role in both spiritual and cultural gatherings and symbolism. The site is listed with UNESCO's World Heritage Sites, and it remains one of England's major tourism points.

When a new, £25 million visitors centre was planned for Stonehenge, the project team needed to dedicate an enormous amount of care to minimizing land disturbance. Not only is Stonehenge itself a protected site, but the entire area in which it is located is dotted with ancient, historically significant burial mounds and other archaeologically sensitive sites.

In building the car park and access points for the visitors centre, the high volume of construction traffic and materials and equipment to stage would stress the local soils. NAUE Combigrig®, with its unique,

single-layer fusion of geogrid and nonwoven geotextile, was selected to provide the critical reinforcement, soil separation, and drainage/filtration functions for the visitor centre approach and related staging areas.

Stronger Installation, Less Disturbance

Combigrig® is a unique reinforcement product that provides the exceptional tensile strength of Secugrid® geogrids and a highly durable nonwoven geotextile in a single roll. The geotextile is firmly bonded between the welded, flat geogrid bars, delivering enhanced soil separation and filtration characteristics as well as the high-strength at low strain necessary for long service lives in reinforced constructions.

The wide, lightweight rolls make shipments easy and more sustainable, and the ability to provide multiple functions in a single product means less disturbance of land is necessary. For the Stonehenge site, the utilization of Combigrig® helped

the project team avoid having to prepare the site for two layers of geosynthetic materials. This made the design and installation more efficient and cost-effective.

The Miracle Of The Past And Present

UK-based geotechnical experts SIG supplied nearly 29,000m² of Combigrig® 30/30 Q1 to reinforce the new centre's car park. Located just 1km from the monument – which is about as close as any construction is allowed to the historic site – the site caretakers then shepherd visitors to the stones via an established transport scheme.

Combigrig®'s high strength geogrid and strong filtration and separation geotextile characteristics helped reduce the land disturbance and need for aggregate on site. The availability of the product to be kept in stock locally via SIG's network further decreased site interference and the overall carbon footprint of the construction. These beneficial factors were well appre-

ciated by the project team on such a historic location.

Stonehenge is an extraordinary place, an ancient construction that captivates us still. Today,

modern geotechnical engineering has been added to the site in the form of this visitors centre and some advanced reinforcement solutions from NAUE.



Water gardens on Reden's old mining area are sealed with Bentofix® X

Bentonite Sealing Mat Wakes Sleeping Beauty

Waterfalls, sea roses, steel sculptures, a stream made seemingly of drifting fog – the water gardens at Landsweiler-Reden, Germany, astonish visitors. Though miners once toiled there in bleak conditions, the site is now a place characterized by geothermal energy, tourism, extraordinary views, and recreation. The fantastic water gardens are a main attraction, and they have been made possible by an efficient sealing system of Bentofix® X2 BFG 5300 Geosynthetic Clay Liner (GCL). Approximately 25,000m² of GCLs have been installed.

The site of the water gardens is in the state of Saarland, a historical mining region. That legacy has left behind many industrial areas and other sites in need of care. In Reden, an organization known as the "Industrial Culture Saar" has executed some fascinating redevelopment projects – most notably, the water gardens.

Taping Of Bentofix® Overlaps
The site was opened in 2012, an event that sought to "wake Sleeping Beauty." The impact



was immediate. Spectators were awed by how dramatically the landscape had changed. Indeed, the organizers had sought to use this site as a way to stimulate interest in other developments. All along, they had planned for this crowning water garden zone to be integrated into the larger region's remediation and redevelopment of old mining operations. And for more than 10 years, as site by site was evaluated for its potential, they had dreamed of waking Sleeping Beauty here.

The site's redevelopment used all available possibilities, with a major driving force to turn the necessities of the work into opportunities. For example, the water needed to be pumped

out of the underground mines. This water was warm, so it was converted to a source of energy production. It was also used to create the "Fog Stream." And since the site's existing brown-fields needed to be capped regardless, the redevelopment team used this as an opportunity to create rainwater and storm water retention ponds.

The Necessity Of A Secure Sealing System

The water gardens involve five connected ponds that branch out and incorporate different water levels. To have this elaborate, aesthetically-driven design over a sensitive site required a secure, long-term barrier system. It was a perfect application for the recently

developed and introduced GCL Bentofix® X2 BFG 5300. To act as a long-term barrier against many kinds of hazardous and chemical liquids – common on mining remediation sites – these Bentofix® GCLs have been engineered with an additional polyethylene (PE) coating. Bentofix® GCLs – also known as geosynthetic clay barriers (GBR-C) – are needle-punched, reinforced composites that combine two durable geotextile outer layers and a uniform core of high-swelling powder sodium bentonite clay.

This construction forms a shear-resistant hydraulic barrier with self-sealing and re-healing characteristics. Additionally, the Bentofix® X series is coated with a durable and uniform polyethylene (PE) coating on the woven side, creating an additional low permeability barrier prior to hydration. It combines the benefits of bentonite and a PE coating in one multi-functional barrier system.

Constructing A Critical Subgrade Seal

The subgrade throughout Reden's old mining area and its railway network is very permeable. It is characterized

by a mixture of old crushed rock from track beds, unknown fill material, contaminated soils and coarse grain soils.

In redeveloping the site and making the water gardens possible, the initial planning phase looked at using a 500mm-thick compacted clay as a seal. However, this sealing system would not have worked with the many known and anticipated penetrations and connections to structures, such as concrete stairs, pipes, foundations, old and new walls, etc. With Bentofix® X, the concerns were resolved. Batten strips secured the Bentofix® panels to structures and appurtenances to ensure firm seals throughout the system.

Bentofix® X Section And Cover Soil Placement

To ensure that the PE coated GCL was not damaged during installation, a needle-punched Secutex® R 404 nonwoven was placed under and over the GCL. Since the subgrade material was expected to be very coarse in several places, the designers wanted to ensure that the bottom geotextile of Bentofix® would not be damaged. For this reason, Secutex® was laid

under the Bentofix® GCL. Secutex® on top of Bentofix® protects the PE coating from being damaged during the cover soil placement process, as well as during the service life against any loads occurring from above.

The smart design and careful construction works ensured that the Bentofix®-based barrier system began its service life in optimal condition. And with the geotechnical and environmental protection issues taken care of, the remarkable surface aesthetics were able to be developed.

Overall, 25,000m² of Bentofix® X2 BFG 5300 and twice that amount of Secutex® R 404 were installed according to the following cross-section (from top to bottom):

- Pond beds with different types of vegetation
- Nonwoven protection geotextile, Secutex® R 404
- GCL, Bentofix® X2 BFG 5300
- Nonwoven protection geotextile, Secutex® R 404
- Leveling material for subgrade (aggregate 0/16mm)
- Subgrade



Mediterranean coast road with geogrid-reinforced retaining structures

Secugrid® reinforces and reduces journey times on "La Rocade méditerranéenne" in northern Morocco



The Rocade méditerranéenne is a traditional coast road which runs along the Mediterranean from the port city of Tangier in northern Morocco to Saidia in the east of Morocco on the border with Algeria.

While the predominantly jagged landscape captivates tourists with its fascinating views, it represents a major challenge for road designers and builders. To increase safety and raise average speed on the road, extensive slope-stabilisation measures were called for. In order to evacuate runoff from the mountains behind, in some places these structures had to incorporate large culverts. The design engineers selected a WRAP solution using gabions. NAUE Secugrid® PET geogrids were used in combination with local soil in one section of the project, yielding a long-term, safe, and economical reinforcement solution.

Infrastructure improvement and the promotion of regional development are important issues throughout the world. In Morocco this was the case with the traditional "Rocade méditerranéenne" road. This important coast road winds 510km along the Mediterranean to the eastern border of the country. Since the whole stretch was in very poor overall condition, the Ministry of Transport decided to undertake extensive repairs which included widening and partial re-routing of the road. The principal objectives were to optimise the alignment and improve the quality of the pavement in order to shorten journey times along the Mediterranean coast.

Mountainous And Jagged

Northern Morocco is mountainous and jagged. Slope failures, undercutting by the sea, and landslips are characteristic of the area, and these contribute to making road

construction all the more difficult. The re-alignment was planned in an extremely efficient manner. Complicated, expensive structures were rejected in favour of economical, safe alternatives with geogrid-reinforced soil embankments. These structures permitted optimum road alignment and resulted in savings in construction time.

"Extremely Demanding"

The road was constructed in several sections. The 46km long section between Tétouan and Oued Lau was the main stretch foreseen for the use of geogrid reinforcement.

Here, BBG Bauberatung Geokunststoffe (Germany based geosynthetics consultant) were charged with the design of a total of 11 sections with an overall length of approximately 1.4km. The final plans called for road embankments with slope angles of around 65° and heights of up to 25m.

The stability of these steep embankments was ensured by designing them as geogrid-reinforced structures. The slope facing utilised a wrap-around system (WRAP) and gabions. Crucial in the choice of this type of system was the fact that it allowed the retaining structures to be traversed by culverts, which

were required to allow passage of surface runoff from the mountains passage uphill of the structures. The collector system on the uphill face, with numerous pipes penetrating the structure, and the cascades on the downhill face necessitated an extremely robust, erosion-resistant outer facing system combined with a stilling pool at the foot of the steep slopes. Secugrid® PET geogrids with tensile strengths between 40 and 200kN/m were used.

Secugrid® is a strip geogrid for soil reinforcement; it is made from drawn, monolithic flat bars and possesses a high junction strength. Its excellent long-term performance and high design strength were instrumental in enabling the alternative construction solution for the Moroccan roadway. A total of over 300,000m² of Secugrid® PET geogrids were installed in the section described. The use of locally available soils in the structures

made for a solution which was both economical and ecologically sound. Today, the completed route is a time-saving, high-quality coast road that allows more intensive access by tourists to these very scenic areas.

This major project demonstrates once again how the use of geosynthetics enables the construction of sophisticated structures even under difficult local conditions.

Exhibitions

| Month | Event | Location |
|-----------|----------------|---|
| January | 09. – 10.01.14 | 44. IWASA (Internationales Wasserbau-Symposium) Aachen, Germany |
| | 15. – 17.01.14 | Infratech Essen, Germany |
| | 21. – 22.01.14 | Deponietechnik 2014 Hamburg, Germany |
| | 30.01.14 | Bautex Chemnitz, Germany |
| February | 04. – 05.02.14 | Middle East Rail Dubai, United Arab Emirates |
| | 20. – 21.02.14 | Die sichere Deponie, SKZ Würzburg, Germany |
| March | 20.03.14 | 21. Darmstädter Geotechnik-Kolloquium Darmstadt, Germany |
| May | 05. – 09.05.14 | IFAT Munich, Germany |
| | 21. – 23.05.14 | HTG Jubiläumskongress Berlin, Germany |
| September | 21. – 25.09.14 | 10th International Conference on Geosynthetics Berlin, Germany |
| | 23. – 26.09.14 | 33. Baugrundtagung Berlin, Germany |